Administrative Science Quarterly

Dedicated to advancing basic understanding of administrative processes through empirical investigation and theoretical analysis.

DECEMBER 1956

Special Issue on the Administration of Research

Administrative Processes of Contract and Grant Research
Alan C. Rankin

Nine Dilemmas in Industrial Research
Herbert A. Shepard

Social Factors Related to Performance in a Research Organization
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Research Notes and Comments

Book Reviews * Abstracts

PUBLISHED BY THE GRADUATE SCHOOL OF
BUSINESS AND PUBLIC ADMINISTRATION

CORNELL UNIVERSITY, ITHACA, NEW YORK

Administrative Science *Quarterly*

PUBLISHED FOUR TIMES A YEAR BY THE GRADUATE SCHOOL OF BUSINESS AND PUBLIC ADMINISTRATION, CORNELL UNIVERSITY, AT ITHACA, NEW YORK.

VOLUME I, NUMBER 3, DECEMBER 1956

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Subscriptions: Domestic and foreign, $7.50 a year; single copies, $2.00; student rate, $4.00 a year. Make checks payable to Administrative Science Quarterly.

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An abstract of not more than 125 words should accompany each manuscript.

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Alan C. Rankin

The Administrative Processes of Contract and Grant Research

Research sponsored by government has now reached major proportions and has general significance for higher education, for national security, and for free inquiry. This paper reports some results of an extended study conducted in the major research agencies of the federal government. Despite the distinctive character of research, the processes of administering contract and grant research parallel those identified for other types of activities. The relative newness of these programs permits the study of administrative processes as they are developing. The specific processes involved in contract research administration are those of determining areas of research interest, evaluating and selecting proposals for support, negotiating and supervising research projects, and evaluating results.

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CONTRACT research has become an important activity of the federal government only in recent years.[1] Except for assistance given research in state agricultural experiment stations, most of the government's research work prior to 1940 was done within the government. World War II gave contract research a tremen-

[1]In this paper, the term "contract research," unless specified otherwise, refers to research grants made by the Public Health Service and the National Science Foundation as well as to contracts for research made by other agencies.

dous impetus. The urgency of meeting wartime needs made it necessary to utilize the country's entire research potential. Government agencies contracted for research with both profit and nonprofit institutions. In 1953 federal expenditures for scientific research and development totaled $2,200,000,000, which represented twenty-two times the expenditure in 1940.[2] Only 25 per cent of this amount was for research performed in government-owned facilities.[3] Most of the major government agencies have contract research programs. Thousands of government employees and hundreds of universities and industrial concerns are involved in projects concerning the major areas of scientific knowledge.

As might be expected, the rapid growth of contract research programs resulted in important problems of a political and administrative character with deep significance for administration, education, and research. Some of these problems, stated as questions, are set forth here to illustrate the implications that government-sponsored research programs have for students of administration:

(1) Does the government have a unified and coordinated policy toward research? There appears to be a dual but conflicting need —first, for some authoritative means of broad coordination and direction of research and, second, for some way of ensuring the wise and responsible exercise of such authority.

(2) Are the total needs for research being met? Is there a satisfactory balance in the support of both basic and applied research? Are some scientific areas neglected? Does unnecessary overlapping occur?

(3) Why does the government contract for research? On the other hand, why does the government not contract for *all* of its research? What criteria exist for making such determination?

(4) How do government agencies decide which of many re-

[2]U.S. National Science Foundation, *Federal Funds for Science*. Vol. III, The Federal Research and Development Budget, Fiscal Years 1953, 1954, and 1955 (Washington, n.d.), p. 41. The present annual rate of federal expenditure for research is more than double the annual total governmental expenditure in the period just prior to World War I. See U.S. Department of Commerce, *Historical Statistics of the United States 1789–1945* (Washington, 1949), p. 299.

[3]U.S. National Science Foundation, *Federal Funds for Science*. Vol. II, The Federal Research and Development Budget, Fiscal Years 1952, 1953 (Washington, 1953), p. 5.

search proposals to support? What criteria are considered? Is it possible to plan research programs to obtain balance in various fields?

(5) Are funds available for a sufficiently long period to permit the research needs to be met? Should the government pay all the costs of research? Does the recipient agency have some responsibility for costs?

(6) Can the government supervise research programs without interfering with the freedom necessary for effective research? Are the administrative procedures developed for contract research contributing to the fulfillment of the research programs? Are existing concepts of governmental administration in general being modified?

(7) How are the results of research evaluated, disseminated, and utilized?

(8) What is the effect of contract research on the colleges and universities? Does it contribute to their primary objectives? What imbalances may result from overemphasis on some scientific fields? Does secret research have a place in the university laboratory?

The import of these questions has attracted the attention of the Congress, governmental officials, university administrators and faculty, and leaders in industry and science.[4] Our particular interest and concern have been with the questions which relate to the administration of the contract research programs by various governmental agencies. What are the processes which have been developed and utilized in administering these programs? In short, what are the administrative processes of contract research? By indentifying, examining, and analyzing them we should gain insight and understanding of the problems associated with this new and vital activity of our government.

Data for this study were obtained over a two-year period during which several months were spent in government agencies

[4]One agency of government, the National Science Foundation, was established in 1950 with a responsibility "to develop and encourage the pursuit of a national policy for the promotion of basic research and education in the sciences." President Eisenhower has, by executive order, broadened and strengthened the role of the foundation. Today, in addition to active support of research by financial grants, the foundation is giving close attention to the nature and status of research in the United States.

in firsthand observation. Agencies included were the Departments of Agriculture, Air Force, Army, Navy, the United States Public Health Service, and the National Science Foundation. Interviews were conducted with nearly one hundred persons. Access was afforded to official documents, correspondence, and reports.

There is another value in the study of the administrative processes of such a major governmental undertaking. This stems from a concern about the nature of the administrative process in the abstract and a desire to provide data which, it is believed, will contribute to increased understanding of the processes of administration.

Edward H. Litchfield, in the initial issue of this *Quarterly*,[5] has provided provocative and pioneering notes toward a general theory of administration. He suggests that the administrative process consists of an action cycle which includes decision making, programming, communicating, control, and reappraisal. Moreover, he suggests the universality of this process. Finally, he sets forth a number of hypotheses for consideration and research and invites confirmation, refutation, and critical analysis. This paper substantiates the Litchfield thesis insofar as the administration of contract research is concerned.

The major processes as they take shape in administering contract research are:

(1) Determining areas of interest for research (policy decision).

(2) Selecting proposals for financial support, including the development of criteria of selection (programming).

(3) Negotiating and awarding contracts (communicating).

(4) Supervising the scientific and business phases of contract research (controlling).

(5) Evaluating and disseminating research findings (reappraising).

These processes arise from the agencies' attempts to answer such questions as "In what scientific areas shall we support research?" "What specific proposals shall we support?" and "How much control shall we exercise once the decision to support is reached?"

The fact that these processes are identifiable does not suggest

[5]See E. H. Litchfield, Notes on a General Theory of Administration, *Administrative Science Quarterly*, 1 (June 1956), p. 3.

that they are discrete and do not overlap, that one has no effect on another, or that administration of contract research is a series of simple procedures. To the contrary, contract research is a complex undertaking involving the interaction of a variety of complicated forces. In the paragraphs which follow, the broad processes are examined more fully.

DETERMINING AREAS OF INTEREST

This process is carried on at two levels. First, the Congress has provided more or less specific roles for government agencies in the basic legislation creating such agencies. With the exception of the defense agencies, the general field of research interest is provided by law, but provided in varying degrees of specificity. The Department of Agriculture is not only authorized to engage in research but the areas of research are specified in law as well. In contrast, the Office of Naval Research is charged with "the encouragement, promotion, planning, initiation, and coordination of Naval Research." The National Science Foundation is authorized and directed "to initiate and support basic scientific research in the mathematical, physical, medical, biological, engineering, and other sciences." The Public Health Service is authorized to support medical research in such specific areas as cancer and heart disease. The defense agencies are less restricted. The function of national defense is so sweeping that great difficulty would be experienced in delineating in law specific areas of research interest.

A second level on which the areas of research interest are determined is found in the agencies themselves. In general, the underlying criterion has been the general mission of the agency, but within that broad framework narrower and more specific fields of interest are developed after discussion and decision among the appropriate personnel of the agency. This process is complicated by a need for knowledge about the research activities of other agencies, as well as a thorough grasp of the resources and need for research in a variety of scientific areas.

The early patterns of contract research in the Navy and the Public Health Service were in part determined by the fact that these agencies took over the supervision of contracts which the Office of Scientific Research and Development had negotiated

during the latter part of World War II. From the early days of the Office of Naval Research (then the Office of Research and Inventions), however, attempts were made to specify general areas of research. In 1946 an advisory panel was created to outline research areas as a framework for the support of a program in the field of human relations.[6] By 1953, and after several redeterminations of areas of interest, the Office of Naval Research had defined an area of psychological science which was divided into three areas in which research was supported. These were physiological psychology, group psychology, and personnel and training. These areas were further subdivided into smaller areas of research interest. In the area of physiological psychology contract research was more heavily supported in the psychophysiology of sensory mechanisms and in the problems of perception and orientation in space than in physiological and psychological aspects of behavior. In group psychology cross-cultural research was no longer supported because it was not thought to be directly related to the Navy's mission. The process of designating other scientific areas evolved in much the same fashion. Advisory panels were utilized in determining areas of research interest, and particular attention was given to the research activities of other government agencies.

The Departments of the Army and Air Force made no significant departure from the process utilized by the Office of Naval Research. The Director of the Air Force Office of Scientific Research reported in an interview: "We determine the fields of science in which we may expect useful applications to Air Force problems. We scrutinize these fields and allocate effort to subfields most important to the Air Force development program." Areas of research interest were selected by the scientific staff of the Office of Scientific Research with the assistance of a body of distinguished scientific advisers. The applied contract research activities of the Air Force were closely related to the specific needs and objectives of the department. Problems were defined by Air Force personnel and contracts were negotiated for certain phases of the selected problem.

[6]The areas are set forth in Harold Guetzkow, ed., *Groups, Leadership and Men* (Pittsburgh, 1951), p. 6.

While the Congress has been explicit in specifying areas of research interest for the Public Health Service, the service had twenty-one study sections which, among other duties, had "responsibility for analysis of the total research in their respective spheres of interest, with determination of neglected or gap areas, and for stimulation of research indicated as needed." These duties were similar in nature to those of the advisory panels in other agencies. Areas of research interest may be modified or abandoned as progress in the elimination or control of certain diseases is made.

The broad areas of research interest of the National Science Foundation are also stated in legislation as noted above. The foundation, however, is not tied to specific program goals as are agencies with programs designed to fulfill an agency need. Consequently, the foundation proposed in its first annual report of 1950–1951 "to support basic research on as broad a geographic and institutional basis as possible."[7] The foundation discovered that the areas of physics, chemistry, and electronics were receiving nearly one-half of the college research effort,[8] and it has accordingly supported research in the biological and medical sciences in more than twice the amount distributed to its other fields of interest.[9]

SELECTING PROPOSALS FOR SUPPORT

Once the areas of research interest have been determined, the next process involves selecting certain proposals for financial support. This procedure consists of two steps: first, obtaining the proposals to which consideration is to be given and, second, evaluating the proposals and selecting certain ones for support. The manner in which these processes are carried on has an important bearing on the significance of the research programs, the caliber of the research performed, and the utility of the research effort.

How proposals are obtained depends in part, but not entirely, upon the basic mission of the agency. The defense agencies

[7]U.S. National Science Foundation, *First Annual Report, 1950–51* (Washington, 1952), p. 16.

[8]*Ibid.*, p. 15.

[9]*Ibid.*, p. 44.

actively foster and solicit the submission of proposals specifically designed to meet the individual agency's needs. On the other hand, these agencies recognize the general value of research in the scientific fields related to their mission. Proposals which are unsolicited are accepted for consideration partly because they are thought to reflect the need for research in various scientific fields.

Agencies concerned mainly with the support of basic research generally receive unsolicited proposals. It may be necessary, however, to advise the nation's scientists that an agency desires to consider proposals in particular areas of interest. This differs from the solicitation of explicit proposals designed to solve a particular problem confronting the agency. Agencies with basic research programs foster the submission of proposals by sending research administrators to professional meetings where they bring the government's interest before the scientific world. Visits to industrial and university laboratories on the part of government scientists also permit the discussion of problems of mutual interest, the publicizing of the availability of federal funds, and the encouragement of the submission of proposals in areas of mutual interest. In turn, university scientists visit Washington agencies or their branch offices to determine what areas of research are of interest to the agencies or to discuss specific proposals or ideas to fit the agency's program.

The process of evaluating and selecting proposals for support has great significance for the quality of the research program. To approve proposals carelessly would be a positive disservice to the concept of federal support for research, would reflect adversely in public attitudes toward government, and might jeopardize national security. To favor the proposals of colleagues or particular institutions regardless of scientific merit would subvert the principles of equity and impartiality in government and might result in the neglect of important scientific fields. But the support of all proposals is precluded by the unavailability of funds and is inconceivable from the standpoint of merit.

Government agencies recognize the importance of the selection process and have instituted procedures by which proposals are evaluated by competent and experienced persons who apply specific and searching criteria.

Proposals are first subjected to a preliminary review which sometimes is routine and perfunctory but nevertheless is important in the implementation of the agency's policy. For example, the National Science Foundation, the Office of Naval Research, the Public Health Service, and the Adjutant General's Office of the Army required the institution to which the scientist submitting the proposal was attached to endorse the proposal. This attempt to ensure institutional backing of the research helps to relieve the agency from criticism for interfering in education. Preliminary review may also indicate lack of information on points which advisory groups will want to consider. Frequently questions arise over proposed salary costs, equipment, or research design, and these may be answered in this preliminary stage.

Another point considered at this stage is the relation of the proposed research to the areas of interest of the agency. One agency had a check list used in considering proposals in its preliminary review. One question was, "Can we justify the proposed contract research as contract research rather than in-service research?" The preliminary review of the proposals requires scientific personnel with a thorough understanding of their scientific field and a knowledge of other government research programs.

After preliminary review, evaluation of the proposal is made by the scientific staff of the agency or by outside consultants or advisory groups. The use of advisory groups is common. The members of such groups are recognized in their scientific fields and have, it is hoped, an understanding of the significance of research, an appreciation of the delicate relation between government and education, and a realization of the critical distinction between control and guidance.

This important phase of contract research programs is not without important problems. Under what circumstances are nongovernmental advisory groups used in evaluating research proposals? What is the degree of responsibility which should be placed on such groups? Are individual consultants preferable? May members of advisory groups award contracts to themselves? If recognized scientists are unable to accept awards because of their participation in advisory groups, what effect is this likely to have on the quality of research?

Answers to these questions are not always found in the policies and procedures of the agencies under study. All referred proposals to someone for evaluation, but the procedures varied considerably. The Public Health Service, for example, relied heavily on advisory councils and study sections for evaluation and selection of proposals; the Surgeon General could not approve a research grant unless it had been recommended by one of the seven advisory councils. On the other hand, the Department of Agriculture did not utilize outside groups or individuals. Evaluations were undertaken by the scientific staff of the appropriate bureau of the department. Other agencies arrayed themselves between these contrasting practices. Thus, the National Science Foundation used panels or consultants to evaluate proposals, but such evaluations were only advisory to the agency's staff and the National Science Board. The Office of Naval Research followed a similar practice in most of its divisions, but the use of committees or panels was diminishing. The Office of Scientific Research of the Air Force was utilizing such groups more and more. In the Department of the Army only the Office of Ordnance Research seemed to make use of outside advisory groups.

There are several reasons why agencies refer proposals to nongovernmental personnel. Not only does such referral afford expert judgment, but it also serves to keep the scientific world more closely informed on governmental activities of mutual interest and to maintain the interest of the nation's scientists in scientific programs of a public character. The interest and support of scientific leaders is also useful in the agencies' relationships with the Congress.

It is necessary to turn to the character and purpose of the research to be performed to explain variation in agency practice. There appears to be a close correlation between the type of research and the use of outside advisers. Agencies which support research for the primary purpose of assisting in the nation's basic research effort utilized outside advisers to a greater extent than did agencies with specific needs in research. The National Science Foundation and the Public Health Service were examples of the former, while the Department of Agriculture illustrated the latter. Agencies with both types of research programs utilized outside

advisers in the former instance and did not in the latter. The Air Force and the Army were examples. Agencies showing a trend toward research of an applied or developmental character used outside groups less often than they had formerly; an example is the Office of Naval Research.

What criteria are used in reviewing proposals, many of which cannot be supported even though there is no serious question about scientific merit? Whether proposals are referred to outside groups or individuals or are considered by the scientific staff of the agency, some basic criteria are applied in the selection process. The criteria appear to be based upon the objectives of the agency. Agencies with the primary goal of assisting in the nation's basic research effort placed greater emphasis on an equitable distribution of contracts than did agencies utilizing research to fulfill the agency need. In the latter case, the utility of the proposal may outweigh geographical or even cost considerations. The following list includes the major criteria agencies utilize in attempting to formulate their decisions. Some are more important than others; some are not considered by particular agencies. But on the whole the fundamental objectives of an agency's mission are reflected in the use it gives them:

(1) Relation of the proposed research to the agency's area of interest, including the degree of concentration of research within a particular scientific area.

(2) Scientific merit or value of the proposed research.

(3) Competence of proposed investigators.

(4) Possible duplication or overlapping with other research.

(5) Geographic and institutional distribution of proposed research in relation to geographic and institutional resources for research.

(6) Cost of proposed research in relation to total funds of the agency available for research and in relation to expected benefits.

(7) Extent of institutional support.

(8) Size of the award involved.

The application of these criteria affords many interesting insights about agency research programs. Unfortunately, space does not permit discussion.

A final stage in the selection process permits consideration of

certain factors which are either too broad to be applied by the scientific staff or outside advisory groups or which need to be applied after the scientific evaluations have been completed. Geographic and institutional distributions may best be considered after the scientific merits of proposals and the competence of investigators have been determined. Also, the relation of research proposals to the agency's over-all research program may require the consideration of persons at a higher administrative level than that required for the scientific evaluations.

Students of administration are familiar with the hierarchical administrative consideration applied to most matters under study in an organization. Research proposals are no exception. Once they have passed the scientific evaluation, they are routed from office to office on their way to the administrative official whose approval is necessary before the contract can be officially negotiated and awarded. Much of this procedure is routine; for example, proposals must be referred to budget offices to establish the availability of funds and to examine certain financial details. The procedure also serves an informational purpose. It is highly important for administrative officials who are called upon to defend agency research programs to be kept closely informed. Finally, the procedure permits the raising of objections to any or all aspects of the proposed research. Officials on this level seldom attempt to consider the scientific merits of the research proposal, but they may be sensitive to controversial subjects which they believe are inappropriate or which might embarrass the agency. As might be expected, this occurs more frequently in the social science area. Research regarding political behavior, religious groups, and communism have been questioned and disapproved on occasion. Finally, the procedure permits administrative officials to raise questions as to whether the proposals are appropriate to the needs of the agency, fall within the program areas, and are fulfilling the general objectives and philosophy underlining the agency's activites.

The use of nongovernmental advisers in governmental activities is by no means considered to be a panacea for all problems in contract research administration. In fact, their use has called attention to some of the problems which seem to be inherent in

contract research. First, applied research and development do not readily lend themselves to evaluation by nongovernmental personnel because the research is designed to meet the needs of the agency. Such needs are not likely to be within the purview of advisory groups. This factor has special significance when it is recalled that over 90 per cent of federal research expenditures is for applied research and development. Second, advisory groups do not always serve the purpose intended. Scientific fields are so broad and complex that it is difficult for a committee to give sound consideration to the variety of proposals. Moreover, members of advisory groups are supposed to be prominent representatives of their scientific fields. Such men are usually too busy to give the time to serve in a regular consultative capacity to government agencies. Finally, experience in the use of advisory groups indicates that group members frequently hold contracts with the agency for which they perform services. No matter what solution to this problem is proposed, science and research stand to lose. If committee members are so competent as to deserve research support but are prevented from accepting it because of agency policy, important research may be neglected. If scientists who are unable to conduct worth-while research serve on committees, the undesirable situation then arises of having second-rate men evaluate the proposals of first-rate men.

These problems are offset by some undeniable advantages. Competent advisers can furnish helpful scientific evaluations as long as the limitations of such a process are recognized. It would be impossible for an agency to retain on a full-time basis the variety of scientific advisers needed, and the procedure now in use affords a reasonably satisfactory method of obtaining scientific advice. A particular value of this method is that it helps keep the scientific world aware of the research activities carried on in the government. Governmental research programs must have the interest and support of the nation's scientists. Furthermore, the troublesome and costly problem of overlapping research is reduced. Exact duplication of research efforts seldom occurs, but a sense of direction in research and in distribution of research effort should help to ensure a more systematic approach to areas needing attention. Advisory groups are especially useful in this respect. Agencies

must weigh the disadvantages against the important contributions that carefully chosen advisers can make to the advancement of scientific research, the spread of scientific information, and the fostering of legislative confidence and support.

NEGOTIATING AND AWARDING CONTRACTS

This major step in contract research is recognized as presenting numerous opportunities to facilitate or hamper research and may influence significantly the character of the government's contract research program. Through negotiation the government agency and the research institution agree on the terms and conditions governing their future relationship. Policies are expressed, considered, and sometimes modified. Special conditions and circumstances are weighed. Compromise characterizes the process. Each research project is negotiated separately, and each separate negotiation represents an important relationship between the public and the government. In each an opportunity exists to advance the cause of scientific research.

In an effort to facilitate research there has developed a distinction between ordinary procurement and the procurement of research. This distinction is illustrated by the negotiated character of research contracts rather than their development through competitive bidding. Negotiation of research contracts is provided for in law in recognition of the unusual nature of research. The limited number of potential contractors, the difficulty of determining costs in advance for many types of research, and the flexibility necessary for research are some of the factors which have led to the negotiation of contracts. Nevertheless, research contracts, even though negotiated, are handled in accordance with the same general procurement procedures and policies in effect for all negotiated procurement.

The negotiation process for supported or basic research varies in some respects from the process used in procuring research services to fulfill an agency need. In the former case the agency would not seek out qualified scientists to submit estimates because such estimates would accompany the proposals originally submitted. Negotiation with the scientist and his institution occurs for the most part after the decision to support a project has been made.

In agencies seeking research services the negotiation process includes the seeking out of an appropriate research institution and of scientific personnel from, perhaps, several sources.

Seven general steps in negotiation may be identified, with some variation noted in their use, depending on the character of the research involved. In supported or basic research some steps, such as considering possible contractors, are unnecessary, and procedures are often less complicated. Research performed to fulfill an agency need is more of a business undertaking. Hence it lends itself more readily to negotiation of terms. The best institution available is sought, terms are considered, and the agreement reached reflects the interests of both the agency and the institution and represents a reconciliation of those interests found to be divergent. The general steps taken in negotiating contracts are as follows:

1. *Receipt of initiating documents.* Official evidence that a research proposal is to be negotiated is contained in an agency form called a project justification or purchase request, or a similar paper. It contains a description of the proposed research; specifications, if appropriate; estimated costs; and other pertinent information.

2. *Consideration of possible contractors.* Contracts may be termed "sole source" or "competitive." If the contract is sole source, this stage is omitted as the source has been determined previously.

3. *Obtaining security clearances.* This applies only to classified research.

4. *Selection of contract type.* Contracts are of two types—fixed price and cost. The negotiator must select the best type of contract for the particular kind of research involved. Most agencies have now had at least ten years of experience with contract types, and standardized practice seems to prevail in their selection.

5. *Request for proposals from prospective contractors.* Official requests including a description of the prospective work are sent to prospective contractors. In actual practice considerable information about a proposed piece of research may be disseminated informally by conversation and correspondence.

6. *Analysis and negotiation.* Proposals are evaluated for scien-

tific merit and business soundness. In the case of research originally submitted to a government agency in order to obtain financial support, only the business details remain to be settled.

7. *Contract award and execution.* After the necessary approvals in the agency have been given, a contract document is forwarded to the contractor for execution after which it is returned to the agency.

A major problem in both the selection and negotiation processes is the length of time required to complete them. Undue haste may have undesirable results, but excessively long periods for selection and negotiation are equally unfortunate since they seem to underline the red tape and complexity associated with dealing with the government. Long delays necessitate expensive revisions in proposals, result in wasted effort, and discourage competent scientists from making the effort necessary to obtain financial support or to respond to the government's need for research assistance.

THE SUPERVISION OF RESEARCH PROGRAMS

All agencies exercise some degree of control and maintain scientific cognizance of the research work being performed. The controls exercised do not involve day-to-day direction of research. They do, however, provide a general supervisory relationship between the government and important segments of the scientific world which permits the government to maintain an interest in programs involving federal funds. Research can thus be hindered by governmental policies and by attitudes of the scientific or administrative staffs charged with supervisory responsibility. Like the other processes of contract research the degree of control exercised has an important relationship to the goal of free inquiry. The problem is how to exercise any degree of control without interfering with research.

The supervisory relationship occurs in two areas, the business management or administrative and the scientific or technical. In the first category, the agency controls expenditures of public funds. The controls are basically fiscal in character and include such matters as the review and approval of cost items, determining overhead, making payments, auditing, redeterminations,

vouchering, insurance, property disposal, and the like. In the second or scientific category, the scientific staff of the agency keeps in touch with the research work in order to keep abreast of progress, and to render assistance if desired.

The National Science Foundation, the Public Health Service, and the Office of Naval Research usually limited their control to requiring submission of fiscal and scientific reports. The scientific reports may consist of only a letter indicating progress and problems. Other agencies were stricter and used such reports as the basis for a critical review of progress in relation to contract objectives. Such a review was conducted by the scientific officers assigned to monitor the project. The reports were thought of as an aid to research by requiring the scientist to appraise his work, to seek implications, to note neglected phases, and to plan subsequent steps. These reports have value in addition to their use as control devices, however. They are necessary to support the research program of an agency when it is justifying budget requests and explaining the research program to other branches of the department, other agencies, the Congress, and the scientific world.

Other supervisory controls include physical inspections of research projects and conferences which may be called to review the status of the project.

Agencies supporting basic research consider that they are helping the scientist do what he thinks is interesting and useful from the scientific point of view. The scientist should know what interests him, and if he is competent he should have some knowledge of what is useful from a scientific point of view. At least the government, in supporting him, takes this position and refrains from interfering unless there is evidence of misuse of federal funds. On the other hand, agencies procuring research services have a direct interest in the successful outcome of the undertaking. To keep the research directed toward the original objective rather than permitting it to follow the special interest of the scientist, closer supervision is maintained than might otherwise be exercised. At the time of this study there was, however, no indication of any belief that the government should control the conduct of research because federal funds were involved. On the contrary, there appeared to be genuine recognition of the need

for complete freedom to pursue research without interference. This attitude prevailed most completely and was most clearly expressed in the Public Health Service, as evidenced by the following statement of two of its officials:

> It is not enough that [the investigator] have the opportunity to compete for funds in any field of research where his natural interests lie; he must also be free in the use of the funds granted to change his research as desired, to permit follow-up of any new and promising leads. Public Health Service research grant policy does permit this sort of freedom and encourages the investigator to use the research funds for the most important research purposes he determines.[10]

Most other agencies do not display such a generous attitude, but there is a widespread attitude of noninterference with the conduct of research.

THE EVALUATION OF RESEARCH PROGRAMS

The final phase of contract research administration is evaluation by the agency of the results of research. Evaluation is undertaken for two reasons. First, research is evaluated with an eye to its utilization. But of greater interest to the purposes of this paper, research is evaluated to determine the soundness of the processes developed for selecting proposals for support and to determine the effectiveness of the research program in general. This evaluation process results in a continuing reappraisal of the research program of an agency.

The evaluation of research is a continuing process not limited to the period following the completion of the project. Evaluation may begin shortly after research is commenced. This is usually accomplished by inspections, by periodic reports, and by the advisory groups engaged in reviewing over-all scientific programs or in recommending support for new proposals or for renewing old projects. Evaluations of this type permit a continuing reappraisal of program activity and are of great assistance to agencies in determining the soundness of their research programs. All agencies utilized some such means of evaluation to some degree.

Once the research project is completed, a new and final oppor-

[10] E. M. Allen and K. M. Endicott, Public Health Service Research Grants in Biology, *American Institute of Biological Sciences Bulletin* (April 1953), pp. 20–21.

tunity is presented the scientific staff of an agency to review the results of the entire undertaking. Again there is a dual purpose —to determine the utility of the research in relation to the needs of the agency and to undertake a general reappraisal of the quality of research in order to strengthen its research program.

Unfortunately, not very effective means have been employed to accomplish this type of evaluation. It is often unsystematic and lacking in formalized procedure. Some agencies did little or no evaluation of the completed research. Other agencies tended to leave the matter of evaluation to the scientific world at large, which may give some indication of the value of the research results by the interest shown in them.

The kind and degree of evaluation depend considerably upon the nature of the research performed. Agencies supporting basic research rely more on the acceptance of the research by the scientific world than on a rigorous scrutiny by their own scientific staff. The staff has no facilities to permit replication of research and is too fully occupied with administrative duties to engage in research. At best, such staffs can do little more than review the experimental methods utilized, the evidence supporting generalizations, and other criteria available in applying scientific methods.

The Office of Naval Research has on occasion arranged for conferences of scientists to review and evaluate progress in research. One such conference is reported in the volume *Groups, Leadership and Men.* Unfortunately, it has not been feasible to provide such an excellent means of evaluating all research or to ensure for all projects the extensive dissemination given to this particular project.

Applied research is treated somewhat differently. Such research was undertaken presumably to meet an agency need. If a particular need is to be resolved the research findings must be evaluated, adapted, and applied to the problem. But not all applied research has such specific application. It may have been undertaken within a broad area of need. Evaluation must be given to determine whether the research findings have any useful application within that broad area.

The defense agencies, being responsible for the bulk of applied

research, were more likely to be concerned with the evaluation and utilization of findings. Consequently, these agencies engaged in a careful review of the reports of findings. Technical reports were reviewed by the scientific personnel of the agency who submitted recommendations regarding possible adaptation to agency use. The criteria in such evaluation procedures are simple. Is the research sound? Does it have application to agency needs? Application is not, of course, simple. A thorough understanding of the scientific field is required, as well as a thorough understanding of the nature of the agency's needs.

It may be seen that such evaluations contribute materially to a reappraisal of the various research programs of various agencies. As experience is gained with scientists, their institutions, and substantive fields of research, new research programs may be developed, new areas explored, new directions embarked upon, while seemingly less productive undertakings may be dropped.

CONCLUSION

There are many questions which this paper does not attempt to answer. What trends are appearing in contract research administration? What improvements can be made? What contribution does contract research administration have for administration in general? What further applications may the contract device have for administration?

The processes of administering contract research are sufficiently unique as to require new techniques and approaches. The need for scientific personnel with administrative capacity has made new demands upon personnel recruitment. The character of research has resulted in the creation of quasi-governmental groups and agencies which, in effect, have expanded considerably the scope and function of government. Some administrative processes of contract research, however, still rely heavily on long-established governmental practices and procedures. Contract research is a complex governmental activity. Its administration should prove to be a valuable source of study of the administrative process as well as a guide to closer relationships between the American people and their government.

Herbert A. Shepard

Nine Dilemmas in Industrial Research

Differences in expectations, values, and organizational traditions between the laboratory staff and the rest of the company are often reflected in the dissatisfaction of research and development personnel and in managerial doubts and misunderstandings. The difficulty of evaluating research and development activity adds to the instability of the relationship. Limiting the laboratory's responsibility for innovation to questions of technological feasibility further hinders it from becoming fully integrated with the rest of the company. Another common source of frustration and bitterness is the existence of an uneasy compromise between providing laboratory personnel with an environment which rewards scientific endeavor and providing them with an environment which rewards efforts to climb in the business and managerial hierarchy.

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PROBABLY no other branch of industrial activity causes as much managerial unrest and uncertainty as does research and development. The concern is due largely to the enormous difficulty of evaluating the laboratory's actual and potential economic contribution to the firm. The inapplicability of traditional methods of calculation creates an interest in discovering other ways of judging whether performance is good or poor. Through this door

the never-never land of opinion, myth, and prejudice is entered—a land which breeds unrest in manager and scientist alike.

It used to be said that the way to do industrial research was to hire good scientists and leave them alone. Certainly no such simple formula can be taken seriously today. But neither have we arrived at the point where discovery of the secrets of successful research and development management can be claimed. Perhaps the best that can be done at present is to impose some order in the never-never land—to identify some of the problems that make for unrest and some of the issues that need to be resolved.

THE LABORATORY: DEPARTMENT OF TODAY OR DEPARTMENT OF TOMORROW?

The needs of the firm as interpreted by top management exert a powerful influence on the laboratory. For public relations purposes—and it is generally held that a number of laboratories have been founded primarily for the sake of institutional advertising—the laboratory is likely to be referred to as the "Department of Tomorrow." In many companies, however, "today" is the principal concern of the laboratory, which may be quite incapable of bringing about a different tomorrow. The potential of the laboratory may not be understood, because of inadequate representation in top management. Even where it is well represented, its scope is likely to be limited to questions of technological feasibility; hence its power as an innovative force is less than it might be.

While certain kinds of new products and processes are undoubtedly desired by most companies engaged in research and development, other requirements are likely to have high priority. Many, and in some cases nearly all, of the laboratory's activities contribute relatively little to the development of new products and processes. For example, technical assistance and "trouble-shooting" in other parts of the company take up much laboratory time. Some laboratories are required to supervise quality control activities. Defensive research must be carried on; i.e., limited resources must be devoted to keeping abreast of certain fields, not with a view to innovation, but to ensure that the company would

not be far behind its competitors should one of them take an innovative step. Similarly, much effort may be devoted to imitative and substitutive work, to match competitors' products. Patents may be produced for trading purposes only. In industries where technology is complex, the laboratory may be regarded as a training ground for managers and specialists needed in other parts of the company.

Thus in industries which are highly competitive, where no firm has a large cushion of monopoly, the laboratory is needed to meet immediate competitive threats, and few resources are available for expensive innovation or long-term research. The consequences for the scientific staff of the laboratory are likely to be frustration and disillusionment.[1]

A "research-minded" top management in a company able to make the high-risk investment involved in long-term research and development provides a different environment for the scientific staff. Many companies have established research centers with campuslike surroundings and an "academic" atmosphere. The term "research-minded" is a common one in laboratories and seems to refer not only to an interest in taking a risk of this kind, and hence a willingness to make a long-term investment, but also to an understanding of and sympathy with the needs and desires of research and development personnel. Sometimes the term seems to mean an interest in research for its own sake.

Many other sets of managerial expectations also have an influence on the laboratory. Company policies and procedures, beliefs about proper methods of organization, stereotypes about research and scientists, and comparisons between the conduct of laboratory personnel and other company personnel draw certain patterns of response from the research and development staff. All such outside forces influence the internal structure of the laboratory organization and affect the attitudes and activities of research personnel and the contribution of the laboratory to the firm.

[1]Warren G. Bennis, "Role Conflict and Market Structure in Two Physical Science Research Laboratories" (unpublished manuscript, Massachusetts Institute of Technology, 1953). See also Bennis, The Effect on Academic Goods of Their Market, *American Journal of Sociology*, 62 (July 1956), 28–33.

THE SCIENTIST: LOCAL OR COSMOPOLITAN?[2]

Company policies and practices are usually intended to ensure a prior interest in the company's welfare on the part of every employee, to lead him to identify his own success with the company's. Salaries, fringe benefits, personnel programs, and the implied threat of punishment for disloyalty are employed to this end. The scientist may, however, identify himself primarily with his professional group. Professional and scientific values emphasize the importance of contributing to knowledge, and prestige is granted on this basis. The scientist is supposed to be guided by intellectual curiosity. His motto is, "How much do we know about this?" whereas the businessman's motto is, "What is the value of this to the company?"

These conflicting forces are disruptive not only of laboratory-company relations, but also of relations within the laboratory. The research staff itself is likely to be divided into what Robert Merton calls the "cosmopolitans" and the "locals."[3] The former are oriented toward success as members of their profession, and their interest in the company is limited to its adequacy as a provider of facilities for them to pursue their professional work. Since they are productive, they may be valuable to the company, but such value is an almost accidental by-product of their work. The locals are good company men, but their interest is likely to be less in their work than in their advancement in the company. They may therefore be of less value to the company than the cosmopolitans. This state of affairs creates a dilemma for management. The locals are likely to be more observant of company

[2]The following four sections draw upon a number of sources, principally Lowell W. Steele, "Problems of Integrating Scientific Research and Industry" (unpublished doctoral thesis, Massachusetts Institute of Technology, 1952); Warren G. Bennis, "The Social Science Research Organization: A Study of the Institutional Practices and Values in Interdisciplinary Research" (unpublished doctoral thesis, Massachusetts Institute of Technology, 1955); and R. K. Merton, *Mass Persuasion* (New York, 1946).

[3]Robert Merton, "Patterns of Influence: A Study of Interpersonal Influence of Communications Behavior in a Local Community," in Paul F. Lazarsfeld and Frank N. Stanton, *Communications Research, 1948–1949* (New York, 1949). Pelz and associates use the terms "institution-oriented" and "science-oriented" to make a very similar distinction. See Donald C. Pelz, Glen D. Mellinger, and Robert C. Davis, *Human Relations in a Research Organization,* I and II (Ann Arbor, Mich., 1953).

policies and procedures, create fewer "human relations problems," and in all disciplinary respects be good employees. The cosmopolitan is more likely to be a "problem person," without whom the organization would function more smoothly.

THE RESULTS OF RESEARCH: GUARDED SECRETS OR ADVERTISED ACHIEVEMENTS?

The company's interest in a research program depends in part on the prospect of profit resulting from the lag between itself and its competitors in the introduction of a new product or on the prospect of a more permanent monopoly. In companies which owe their past success in part to the careful protection of "trade secrets" there is usually a desire to keep the laboratory activities under wraps. The scientist's professional standing depends, however, on publication of his achievements. Even where secrecy is not the issue, management may deplore the cost in professional time and laboratory expense required to prepare material for professional publication or for presentation at meetings of professional societies. Despite C. F. Kettering's dictum to the effect that locking the laboratory door excludes more than it keeps in, and despite the importance of establishing a good scientific reputation for the laboratory as a recruiting device, relatively few managements actively encourage publication of research results.

THE BUDGET: COMPANY TIME OR RESEARCH TIME?

Companies operate on annual budgets, but research and development projects are likely to go on for years without producing useful results. It may take a long time to investigate a research problem even to the point of estimating the probabilities of eventual solution, and this is a source of strain between scientist and businessman. Management is frustrated by its inability to determine whether progress on a project is as good as could be expected; the research staff is frustrated by management's inability to understand the nature of the technical problem. This communication gap can lead to demoralization of the research staff and to a loss of confidence on the part of management. Or it may lead to more complicated states of affairs. For example, the laboratory may report only on those projects in which it can

show the kind of progress that management understands, other research activities being "smuggled."

In another way as well, difference in time perspective produces conflict. To the company, a new competitive threat, a delay in production, a dissatisfied customer are problems demanding immediate attention. To the research worker with his heart in a long-term project, such problems are irritating interruptions, and if he is frequently called upon to "put out fires" he is likely to become resentful and suspect the sincerity of management's support of his work.

AUTHORITY: DELEGATED OR SHARED?

Two organizational traditions, the professional and the industrial, meet in the laboratory. Internal organization of the laboratory will be discussed in greater detail below, but certain conflicts between the two traditions can be pointed out here. Industry respects certain kinds of orderliness in productive organization, and takes them as evidence of efficiency. Thus centralizing services, controlling hours of work, budgeting time, controlling expenditures and decision making by graduated delegation of authority from top to bottom, and many other practices are regarded as elementary principles of good organization.

The scientific and professional organizational traditions are based on assumptions that are different from those of industry in some respects. In the first place, power is supposed to be exercised not from top to bottom, but sideways. Achievement is evaluated by "the weight of scientific opinion." Unless a colleague's competence or honesty becomes suspect, he is expected to make all decisions relating to his work for himself. The idea of a boss is an anathema, as are the other external controls imposed by industrial methods of organization—in fact, they are held to be inconsistent with the basic tenets of professionalism. "Professional people work as 'senior' and 'junior' rather than as 'boss' and 'subordinate'. . . the professional thinks of [a project] as a group project, with each member of the team having independent responsibility vested in him."[4]

[4]Peter F. Drucker, Management and the Professional Employee, *Harvard Business Review*, 30 (March-April 1952), 86.

Most laboratory managements make certain gestures in recognition of the scientist's "rights" as a professional. For example, time clocks may be omitted, or the scientist may be allowed to incur expenditures up to a certain amount on his own authority. Nonetheless, there is continual pressure from management for more conformity to its organizational ideals, even including such matters as neatness of dress, regular hours, and a more systematic approach to the coffee break. At the same time there is continual pressure from the research staff for more "freedom."

ORGANIZATION: PROJECT GROUPS OR FUNCTIONAL GROUPS?

There is a strong tendency for laboratories to become organized "functionally" into permanent specialist groups—a process whose consequences for morale and productivity are hard to assess.[5] There is some evidence that it has a depressing effect on creativity, enthusiasm, and interpersonal and intergroup cooperation.

Many forces operate so as to divide the laboratory into specialist groups. Efficient processing of common classes of problems suggests the desirability of placing together those who have expert knowledge of a given class. The principle of putting like specialists together is quite in accord with professional organizational traditions. Just as this arrangement makes for understanding by one's colleagues, it makes for objectivitiy in personnel evaluation by the supervisor, by enabling him to compare his men's performance on similar tasks. Similarly, it facilitates observance of such matters as the submission of technical reports and other rules and regulations. Moreover, it permits each man to be employed at the work he does best and allows him to develop as a professional specialist. It provides him with a secure status in the company, and a clearly defined path of advancement. It makes for good communication between the laboratory and other parts of the firm, through the group's permanency and the rich background of experience it obtains on the class of problems assigned to it. It makes for reliability in budgetary forecasting;

[5]Paula Brown, Bureaucracy in a Government Laboratory, *Social Forces*, 32 (March 1954), 259–260.

with experience, the specialist group becomes able to predict its requirements.

Functional organization has its disadvantages, however. Among the shortcomings mentioned by laboratory managers are resistance to crossing specialist boundaries and cooperating with other groups; a tendency to work on ever more specialized problems of ever decreasing significance; lack of creativity and responsiveness to challenge—the scientist becomes a specialist in knowing what cannot be done and is afraid to venture into unfamiliar fields. The permanency of groups in a functional organization may be detrimental; the author and his associates found that colleague, self, and management ratings of research and development groups fell off directly with the length of time members had been associated with one another.[6]

An alternative to functional organization is organization by *ad hoc* project teams, with specialists from various fields as members, so that each team is equipped to solve a particular complex problem requiring knowledge from several disciplines. Since many problems are of this character, the project-team approach has an immediate and obvious advantage over the functional approach. The team members' energies and interests are all concentrated on a single complex problem. Such teams often turn out to be enthusiastic, creative, and dramatically successful.

Unfortunately, organization by this method presents serious administrative and personnel problems. Project teams tend to perpetuate themselves and become specialist groups, there is often strong resistance to project termination and transfer to new groups. As team members, research workers do not achieve the high degree of specialized knowledge the laboratory requires to keep abreast of advancing technology. The project tends to rely too much on its own resources, and resists consulting the literature or other specialists. Teams sometimes ignore rules and regulations and are hard to discipline. Intergroup jealousies are frequent. Too much depends upon the leadership and technical competence of the team's supervisor; men with the necessary qualities are rare. The path of promotion is not clear; supervisors have to evaluate repre-

[6]Herbert A. Shepard *et al., Some Social Attributes of Industrial Research and Development Groups* (Progress Report, Massachusetts Institute of Technology, 1954).

sentatives of several disciplines, and may lack the knowledge to do this objectively; project termination causes insecurity. Incompatibility of team members can have a disastrous effect on performance.

In most laboratories, some combination of functional organization and *ad hoc* team organization is used. Each appears to have its advantages and disadvantages from the point of view of administration, productivity, creativity, and satisfaction in work. Choosing the most appropriate combination of functional and project modes of organization is not the only organizational problem in the laboratory, however, nor does its solution automatically take care of all human relations problems.

RESEARCH MANAGEMENT: FULFILLMENT OR REGRESSION?

Studies by Donald C. Pelz and associates[7] have emphasized the importance of leadership style for the job satisfaction and effectiveness of research workers. Pelz's results indicate that dominating supervision produces apathy and resistance, and that laissez-faire or inactive leadership produces dissatisfaction and low productivity. An active, stimulating leadership role is associated with good performance and high morale. Studies by C. D. Orth and Ralph Hower[8] point in more detail to the various roles the research supervisor has to take. He must understand the needs of groups and individuals in his organization and other parts of the company. He must be interpreter of the group's needs and achievements to higher levels of management and act as interpreter of managements' requirements to his group. He must protect the group from demands and pressures which he believes would adversely affect it. He is a source of technical guidance and judgment, of inspiration and stimulation. He must coordinate the ideas and resources of his group. Studies by Shepard and associates show the successful research group leader to be a more active social being than the unsuccessful group leader. He has many friends in the laboratory, centers his social life around the labora-

[7]Pelz *et al., op. cit.*

[8]Communication from C. D. Orth, III, in seminar, Massachusetts Institute of Technology, 1954.

tory. Studies by M. I. Stein[9] suggest that the successful research group leader has certain charismatic attributes: subordinates tend to identify with him and model themselves on his pattern.

All of these observations point in the same direction: the effective research group leader is a creative, dynamic, enthusiastic person who relates easily to others. Such men are said to be rare among engineers and scientists. According to Anne Roe,[10] the successful natural scientist typically avoids interpersonal intimacy. According to H. B. Moore and S. J. Levy,[11] the engineer is usually an authoritarian who attempts to handle all problems by impersonal regulations and procedures.

David Moore and Richard Renck find that scientists and engineers typically "view the organization as confused and ill-conceived; they view management as confused and ill-advised."[12] The contempt for administrative and other nontechnical occupations is reminiscent of Thorstein Veblen and the Technocrats. Engineers have a strong desire for "status and recognition of their individual accomplishments" and also "desire to be considered an integral part of an organization."[13] The engineer "is tense. Emotions which rise are ignored, suppressed and repressed unless they are so intense that they overwhelm his self-control (which is usually pretty strong). Feelings are regarded as invalid phenomena. . . . Irritability is one of the most common expressions of the tension in engineers."[14]

This mixture of feelings and attitudes implies that the lot of the research administrator is not a happy one. The professional employee resents encroachments on his autonomy. Moreover, the emphasis on individual achievement makes teamwork hazardous. Jealousies, antagonisms, and feelings of injustice are likely to arise over such matters as authorship of reports, patents, and papers.

[9]Communication from M. I. Stein, in seminar, University of Michigan, 1955.

[10]Anne Roe, *Making of a Scientist* (New York, 1953).

[11]H. B. Moore and S. J. Levy, Artful Contrivers: A Study of Engineers, *Personnel*, 28 (Sept. 1951), 152.

[12]David G. Moore and Richard Renck, The Professional Employee in Industry, *Journal of Business*, 28 (Jan. 1955), 62.

[13]G. H. Metz, Management and the Professional Employee, *Addresses on Industrial Relations* (University of Michigan, Bureau of Industrial Relations Bulletin no. 22, 1954).

[14]Moore and Levy, *op. cit.*, pp. 152–153.

Jealousies are likely to be accompanied by disparagement of the professional competence of the others involved, with disastrous effects on collaboration. The phenomena associated with these needs and interpersonal difficulties are the basis for labeling the professional as a "prima donna."

On the other hand, some observers report that the professional works well on a team.[15] Paula Brown stresses the research workers' earnest attempts to govern their behavior rationally.[16] Shepard stresses the free exchange of task-oriented information in the determination of status and the maintenance of cooperative relations.[17] Moore and Levy note that their engineers "seek good relations, smooth interchange and workable friendships with others, and will push their feelings back into unconsciousness if these appear."[18] The major implication of these observations appears to be that the reward system should be sensitive to and accurate in response to individual task-achievement and that the control system should permit a high degree of individual and group autonomy in technical decision making.

Rewarding research workers for good performance presents a difficult administrative problem. In American industrial society, success is measured largely by the size of the organization one controls. But not all successful engineers and scientists are temperamentally suited for supervisory or administrative work, nor would they, as creative research workers, be most profitably employed in such work. Scientists and engineers are themselves somewhat ambivalent about organizational advancement. On the one hand, it may be regarded as the only generally accepted evidence of their value. On the other hand, they fear loss of professional status and competence. Even laboratory officials who have been many years away from the bench are likely to "keep their hand in" by working on some technical project. While this indulgence may be to some extent sentimental, it is also a means of preserving professional self-respect.

Many laboratory managements have attempted to solve their

[15]Drucker, *op. cit.* [16]Brown, *op. cit.*

[17]H. A. Shepard, The Value System of a University Research Group, *American Sociological Review*, 19 (Aug. 1954), 460.

[18]Moore and Levy, *op. cit.*, p. 152.

own dilemma and the successful scientist's dilemma by establishing a "dual hierarchy." One way up is promotion through the ranks of supervision and management. The other way up is through special privileges, autonomy, high salaries, and impressive titles (research associate, senior scientist, and so on) which can be obtained without incurring supervisory responsibilities. Unfortunately the dual hierarchy rarely succeeds in achieving its goal. Sometimes management cannot avoid the temptation to "shelve" someone whose ability to contribute has waned by giving him such a title—thus ruining the title for others. Even under the best of circumstances, the promotion to "senior scientist" is at once a symbol of achievement, and of managerial incompetence.

NONPROFESSIONAL WORKERS: CASTE OR CLASS?

In much that has been said about the scientists and engineers in the foregoing pages, a certain snobbery is implied. Frustrated in his desires for recognition, enforced to conform to regulations that he considers inappropriate for a professional, the scientist or engineer is quite likely to be defensive about his status. Moore and Renck find that "negativism and a tendency to strike out almost indiscriminately at all aspects of the work environment"[19] are associated with the low morale they find to be characteristic of scientific and engineering staffs. One aspect of the environment against which engineers and scientists rebel is the requirement that they do work which they consider "low-level" or "nonprofessional." Many regard participation in activities involving the drafting board, "hardware," and glassware as somewhat degrading, or, as they put it, "an uneconomical use of professional time." This attitude does not endear them to the nonprofessional workers. And given this attitude, any sign of incompetence in these matters on the part of the engineer wins him the enmity of nonprofessional personnel. Such enmities appear to flourish in functionally organized laboratories, where interpersonal difficulties can quickly develop into intergroup conflicts. In project organizations, on the other hand, there often develops an intense loyalty between the professional and nonprofessional members of the team. The pro-

[19]Moore and Renck, *op. cit.*, p. 60.

fessional sometimes regards himself as teacher and protector, the nonprofessional, as student and apprentice.

PROFESSIONAL WORKERS: ELITE OR PROLETARIAT?

To most of us, the term "profession" connotes service or ministry rendered out of specialized knowledge, high standards of conduct (professional ethics), and a kind of democracy as the means of social control within the profession. Altruism is the keynote. In the lay mind, and to some extent in the professional, professional values appear to stand in opposition to wealth- or power-seeking. Certainly for the members of some professions—notably clergymen and teachers—the worldly rewards have been small, and throughout the professions "commercialism" is frowned upon.

While these values are in a formal sense characteristic of professional groups, there is a good deal of variety among the professions in this respect. Moreover, there is in every profession a difference between the announced values and the values that govern in practice. The popular model of the professional visualizes a client to be ministered to, as in medicine and law. The model has to be distorted almost out of recognition if it is to include the members of the engineering department of a large firm. A kind of equalitarianism among the individualistic members of the profession is also part of the popular model: the law partnership, the medical clinic, the university faculty, and the professional society being representative organizational forms. Again, this aspect of the model is abandoned in the engineering department of a firm.

Such departures from the generally accepted model of a profession reduce the meaningfulness of the word. The criteria for professional status become blurred. A host of new "professions" have arisen: public relations, purchasing, cost accounting, personnnel administration, and so forth. Even the idea of management as a profession is not unpopular, though few go as far as Mary Parker Follett when she asserts that "the business man has opportunites to lead the world in an enlarged conception of the expressions 'professional honor,' 'professional integrity.' "[20]

[20]Henry C. Metcalf and L. Urwick, eds., *Dynamic Administration: The Collected Papers of Mary Parker Follett* (New York, 1942), p. 143.

In fact, the professional model is at such variance with the state of affairs in industry that a discussion of professionalism would seem irrelevant here if it were not for the fact that a large proportion of scientists and engineers in industry think of themselves as "professionals." As has already been indicated, this self-definition has a number of important consequences through its effect on attitudes, expectations, and reactions to the demands of the industrial environment.

Concern about the implications of professionalism has been especially keen in relation to the issue of unionism. Professional associations in science and engineering have, with few exceptions, opposed organization of their members for collective bargaining. Accordingly, growth of unions in these professions has been slow. Many industrial scientists and engineers feel that unionization constitutes a rejection of professional ideals and responsibilities and a downgrading in their status to the ranks of labor.

But powerful economic and social forces create a pressure toward unionization. The individual engineer or scientist is no longer an influential member of his company, with a monopoly on specialized knowledge needed by the firm. He is one of a hundred or a thousand such specialists. The individual engineer or scientist is peripheral and replaceable. The parallel with craft unionism is striking. The highly skilled craftsman was once a proud individual, his own master or an influential member of his organization. Just as the guild was a satisfactory association for craftsmen, so the professional society has met the needs of the modern scientist and engineer. Just as the guilds were the predecessors of the unions, though not often their parents, so the professional society may eventually give way to, or at least be supplemented by, the professional union. The means used by professional associations in the past for protecting the economic welfare of their members—primarily control over entry to the profession—may not be adequate to meet the challenge of mass industrial employment.

CONCLUSION

The reader can infer, and any laboratory manager knows, that imposing order on the never-never land of ambiguous relations

between science and industry is a relatively easy matter if the author undertakes no more than a classification of areas of conflict and uncertainty. The really important and challenging job is to determine what can be done to improve the situation. To date, however, most of the formal studies of research organization have necessarily been of the kinds that describe how things are and draw inferences about how they came to be that way. Statistical analysis of data resulting from studies of current practice, or even from more selective observation of things as they are, is often an inefficient path of knowledge. Kurt Lewin once remarked that the theory of gravity was neither conceived nor tested by such methods —and added that the best way to learn how anything works is to try to change it.

There is a crying need for a more action-oriented approach to the study of research organization. Organizational experiments as carefully conceived and carried out as the physical experiments that are conducted in the laboratory are the obvious answer—painfully obvious, surely, to persons who make a career of theory and experiment. Every laboratory in the country unwittingly produces quantities of information bearing on organizational problems—and pours it all down the drain, through a lack of interest and skill in the design, conduct, and analysis of social experiments. There is no shortage of promising hypotheses. But to date there has been a shortage of research laboratories with a will to experiment. Perhaps the same forces that result in a limitation of the laboratory's innovative potential by defining its contribution as "technical" inhibit systematic study of the impact of personal, social, and organizational factors on the conduct of research itself.

Donald C. Pelz

Some Social Factors Related to Performance in a Research Organization

Relations between the social environment provided by the organization and the performance of medical researchers are reported in this article. The study was conducted in a large governmental organization devoted to medical research. Results indicate that scientists tend to perform more acceptably when they are closely associated with colleagues having a variety of values, experiences, and disciplines and when supervisors provide frequent stimulation combined with autonomy of action.

The author is study director at the Institute for Social Research, University of Michigan.

THIS report will summarize some of the highlights from a study conducted in a large government organization for medical research.[1] The organization employs some three hundred investigators who conduct laboratory research on the frontiers of medical knowledge. The organization is regarded by its employees as having an atmosphere similar to that of a large university.

[1]The study was financed by the National Institutes of Health, U.S. Public Health Service, and the Department of Health, Education, and Welfare. Additional analysis and writing were made possible by a grant from the Foundation for Research on Human Behavior, Ann Arbor, Michigan. Assisting in the study were Glen Mellinger, Robert C. Davis, and Howard Baumgartel.

The research is generally of a fundamental rather than applied character, and considerable freedom is allowed the individual investigator.

As part of the study, judgments of individuals' scientific performance were made by panels of investigators. The latter were experienced scientists, nonsupervisory as well as supervisory, who were familiar with the work of the others. Where possible, each scientist was evaluated twice, once in comparison with others in his own laboratory or division, and again in comparison with others in the same scientific discipline. A particular individual might be judged by as many as fourteen other scientists, only one or two of whom would have supervisory authority over him. Essentially, this was an evaluation by one's peers. The assessors' judgments were assigned numerical scores from 1 to 9, the scores from different judges were averaged, and where a scientist received both a laboratory and a discipline score the two results were combined.

In our analyses we wanted to study the effects of the social environment on the individual's performance. For this purpose we wanted to reduce variations in performance caused by individual factors such as basic ability, quality of training, or type of experience. It seemed reasonable to assume that such factors would be reflected in the scientist's amount of education and in his job grade. The data showed that with increase in grade, there was a definite increase in average performance; and non-Ph.D.'s scored lower than Ph.D.'s of equal rank. By adding or subtracting an appropriate constant, an "adjusted" score for each individual was obtained such that the residual variation still associated with grade or doctoral degree was no greater than 0.4 per cent. In this adjusted measure it seems likely that differences owing to individual factors have been reduced.

SCIENCE VERSUS INSTITUTIONAL VALUES

If social factors can influence a person's scientific achievement, they may do so in part by affecting his motivation toward the work. To study such effects it was first important to determine whether motivational factors have any association with performance.

In a previous study of a government organization administering research grants, Dwaine Marvick[2] demonstrated the significance of certain general motivations or values. He isolated two syndromes labeled the "specialist" and "institutional" orientations. The specialist seeks the approval of a larger circle of peers wherever they may be found; the institutionalist seeks rewards within a localized institution. We wanted to know whether such orientations would relate to scientific performance.

In the present study each scientist filled out a questionnaire, one part of which listed nine factors that might be important in a job. Each person indicated how much personal importance he attached to each factor. A correlational analysis located three items which seemed to represent the specialist or (as we named it) the *science* orientation. Another cluster of items seemed to indicate the *institutional* orientation.[3]

In an analysis of these data, R. C. Davis[4] found that the index of science orientation was significantly related to scientific performance, whereas the index of institutional orientation was not. Furthermore, it appeared that a strong science orientation went with high performance mainly when the institutional orientation was weak; strength of science orientation was not significantly related to performance when the institutional orientation was strong.

Similar results were obtained with data from another study conducted at the Institute for Social Research by S. Lieberman

[2]D. Marvick, *Career Perspectives in a Bureaucratic Setting* (Ann Arbor: Institute of Public Administration, University of Michigan, 1954).

[3]The three science-oriented items were: stress on using present abilities or knowledge, freedom to carry out original ideas, and chance to contribute to basic scientific knowledge. The three institutional-oriented items were: stress on having an important job, association with high-level persons having important responsibilities, and sense of belonging to an organization with prestige in the lay community. The latter cluster might also be labeled a "prestige" orientation. The two indexes were neither positively nor negatively correlated; a person high on one might be either high or low on the other.

[4]R. C. Davis, "Factors Related to Scientific Research Performance," in *Interpersonal Factors in Research, Part I* (Ann Arbor: Institute for Social Research, University of Michigan, 1954). See also, R. C. Davis, "Commitment to Professional Values as Related to the Role Performance of Research Scientists" (unpublished doctor's dissertation, University of Michigan, 1956).

and L. Meltzer[5] as part of the Survey of Physiological Sciences sponsored by the American Physiological Society. In a questionnaire sent to a nation-wide population of physiologists, similar questions about the personal importance of various job factors were asked. Scientific performance was measured in this instance by the number of times each person had been cited in the *Annual Review of Physiology* for the preceding three years. When a parallel index of science orientation was formed, a significant relationship was again found with performance. No relationship was found between the number of citations and the scientist's motivation toward prestige items such as advancement in his profession.

These results raise some provocative questions for research administrators grappling with knotty problems of salaries, titles, and promotion policies. The point to be stressed here, though, is that the index of science orientation does relate to actual performance and thus points toward a way in which performance might be increased. Some results to be given later suggest that science motivations may be affected by the type of leadership in the organization. It may also be possible to raise the level of science motivation through the selection of new personnel or through the kinds of recognition given.

CONTACT WITH SCIENTIFIC COLLEAGUES

A second series of analyses approached the question of whether the style of communication with one's colleagues can raise or depress the level of performance. If so, what is the optimal pattern of such contact? Should a scientist rub elbows daily with his peers, or should he be assigned a cubbyhole where he can work without distraction? If frequent contact proves worth while, should it be mainly with others of similar background, with whom he can talk the same language, or would he benefit more by the stimulation of ideas from persons of different backgrounds?

To study these questions G. Mellinger[6] used nonsupervisory scientists at a senior level who were mature investigators at civil

[5]S. Lieberman and L. Meltzer, *The Attitudes and Activities of Physiologists* (Ann Arbor: Survey Research Center, University of Michigan, 1954).

[6]G. Mellinger, manuscript prepared for *Interpersonal Factors in Research, Part II* (in process; Ann Arbor: Institute for Social Research, University of Michigan, 1956).

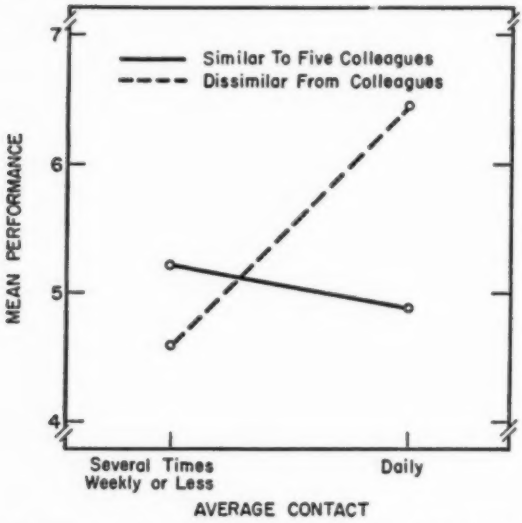

Figure 1. Scientific performance related to similarity to five colleagues in prior employment and to frequency of contact (at senior level).

service grades of GS–12 and higher, with several years of experience.[7] On their questionnaires scientists named up to fifteen people in the organization with whom "some contact is of greatest significance to you in your work," and indicated the frequency of contact with each.

For each respondent we selected the five scientific colleagues he named as most significant, excluding supervisors above him, technical assistants, and administrative personnel. For each colleague we computed a measure of similarity on the science and institutional orientations described above; we averaged these for the five colleagues, and also computed the mean frequency of contact. Figure 1 shows the results when these measures are jointly related to scientific performance.

Among the four possible combinations of frequency and simi-

[7]In the following data a distinction will be made between senior- and junior-level scientists. They differ in experience and in autonomy and may require different kinds of social environment for high performance.

larity, highest performance is found when scientists have *frequent* contact (more than several times weekly) with colleagues who are on the average *dissimilar* from themselves in values.

Increase in contact is significantly related to performance only if colleagues are on the whole dissimilar from themselves. When colleagues have similar values, more frequent contact is not accompanied by higher performance; there is, in fact, a slight decline.[8]

These findings suggest that scientists benefit by frequent opportunities to exchange ideas with persons having different values. Since the institutionally oriented persons in our study tend to lay stress on improving the nation's health, the results might mean that those who emphasize basic research can benefit from contact with those who stress applied research, and vice versa. The interpretation suggested here is that frequent contact with dissimilar colleagues stimulates higher performance. It might also be argued that abler scientists seek out those of different values. The second interpretation seems to be preferred by some scientists who do not feel that social factors can influence level of performance. The facts are, however (from data not shown here), that the colleagues of abler scientists are on the average just as similar to these scientists as the colleagues of less able scientists are to the less able scientists. It does not look as though the more competent investigators deliberately seek contacts with colleagues of dissimilar values.

Another result in a parallel vein was obtained with a different measure of similarity. On the questionnaire scientists were asked about the kinds of situations in which they had previously worked; most frequently named were government, university, and hospital (including private practice). Depending on the number of such situations that they shared in common, each pair received a high to a low similarity score; and the average similarity between a scientist and his five main colleagues was computed.

The results are shown in Figure 2. We note that highest performance occurs when the senior scientist has frequent contact with five colleagues who are markedly dissimilar from himself in type of previous employment.

[8]This does not mean that among this group "the fewer contacts the better." Most scientists report average contacts weekly or more often with their colleagues. Among the few isolates who report less than weekly contacts, performance tends to be low.

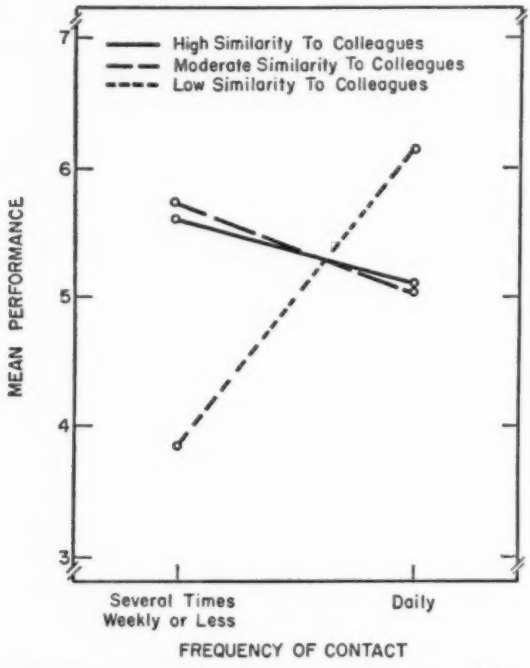

Figure 2. Scientific performance related to similarity in values and to frequency of contact with five main colleagues (at senior level).

Frequency of contact is associated with significantly higher performance only for those scientists whose colleagues are dissimilar from themselves. When colleagues come from similar backgrounds, increase in contact from weekly to daily tends to go with slightly lower performance.

On the other hand. among moderately isolated scientists (who see their colleagues weekly) dissimilarity in previous employment seems to be a handicap; performance is significantly lower in comparison to those having similar colleagues.

It is likely that those who have worked previously in government, university, and hospital situations will develop different views as to the best way of approaching a research problem.

Whatever the nature of these differences, it appears that they can encourage high scientific performance, provided there is ample interchange among the individuals. But diverse viewpoints may be a hindrance if they constitute the only contacts of a relatively isolated individual.

Is the similarity illustrated in Figures 1 and 2 the same thing or two different things? The correlation between the two similarity measures is in fact slightly negative (−.15) and not statistically significant. It appears that we are dealing with two independent kinds of similarity. What their precise nature is remains a question for future research.

Such results raise the question of scientific discipline. Will scientists benefit from close contact with others in different disciplines? Does organization of laboratories along interdisciplinary "project team" lines give better results than organization into single-discipline groups?

In our study we classified each scientist according to the major and minor disciplines he was currently using in his work. These classifications were based in part on the disciplines he named on his questionnaire and in part on the groupings established to assess performance. Similarity scores were assigned, depending on whether scientists had major fields in common, minor fields in common, or no fields in common.

The results of this analysis are not as clear-cut as the previous ones, but they point in a similar direction. In general, senior scientists whose five main colleagues differ from themselves in field of work tend to perform somewhat better; and this tendency is more marked with frequent contact.

The tendencies (according to data not shown here) are also sharper when the colleagues are not equally dissimilar, but vary in their degree of dissimilarity. Thus it appears that for high performance the scientist requires variety in his daily fare. Additional support of this idea will be given below.

CONTACTS WITH SINGLE INDIVIDUALS

The foregoing analyses raised further questions. We have studied contacts with five colleagues; will similar results obtain with the scientist's one most important colleague? And what about his

chief—should the scientist work under a supervisor who is in a different field? To explore such questions we again used frequency of contact and several measures of similarity. The present analysis was extended to junior-level scientists (in civil service grades GS–9 and GS–11, most of whom have doctoral degrees but limited experience) as well as the senior level used previously.

One particularly surprising result emerged, as shown in Figure 3. The measures used are similar to those in Figure 1 except that they refer to the one most significant colleague rather than to an average for five colleagues. The figure demonstrates that high scientific performance is associated with daily contact provided that the scientist's major colleague has *similar* values. By contrast, Figure 1 showed that high performance goes with frequent contact provided that contact is mainly with five colleagues who have *dissimilar* values.

How to reconcile these results? The following view seems

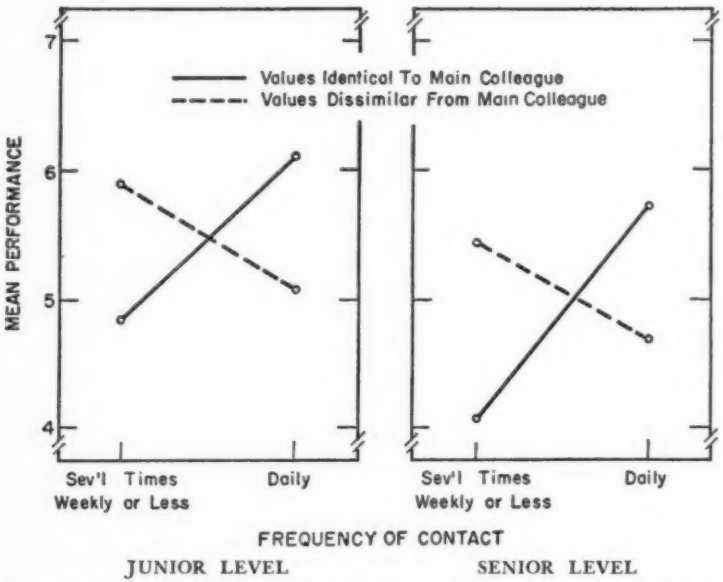

Figure 3. Scientific performance related to similarity in values and to frequency of contact with main colleague.

plausible: For maximum performance it is helpful to have at least one close colleague with a similar orientation—someone who "talks the same language," with whom the scientist can air his problems and get a sympathetic hearing. But one or two such individuals are enough. To provide the stimulation of new ideas, it is important that the remaining contacts be with people of dissimilar orientation. In short, one kind of environment for high performance is frequent contact with a variety of viewpoints, a few similar, but most of them different.

Other conditions for achieving variety are possible. Consider the relatively isolated scientist who sees his colleagues only once or twice a week. The data from Figures 1 and 3 suggest that in this case his major colleagues should possess different values and the remaining colleagues similar ones. Again the principle of variety is indicated.

The same principle emerges when we examine the relationships of the scientist to both his chief and his major colleague in terms of scientific field. The data in Figure 4 show that scien-

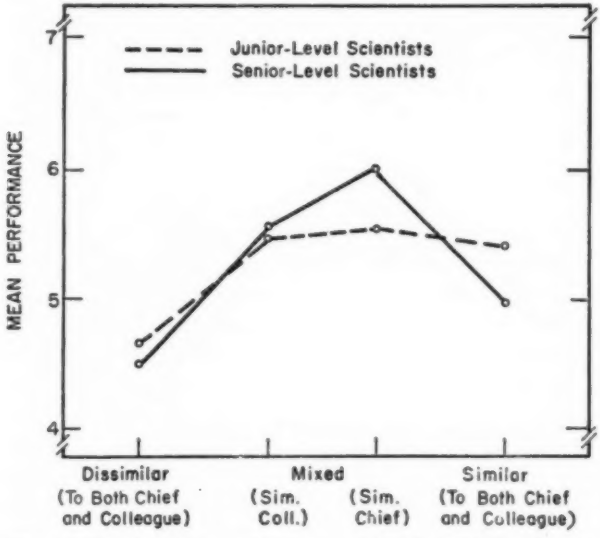

Figure 4. Scientific performance related to similarity of field to that of chief and main colleague.

tific performance tends to be higher if the scientist's chief and major colleague are heterogeneous in scientific field—one similar and the other dissimilar. Lower performance occurs when the two are homogeneous—both dissimiliar to the scientist or (for senior investigators) both similar.

It does not seem to matter whether the chief plays the role of "confidant" and the colleague that of "stimulator," or vice versa. The important thing is that both roles be provided, especially for senior scientists. The key lies in variety.

LEADERSHIP METHODS OF THE IMMEDIATE CHIEF

What sort of supervision do scientific personnel require for maximum performance? One view commonly held is that the scientific supervisor should do little except keep out of the way of his subordinates. The soundest way to encourage high achievement, according to this philosophy, is to secure good people, give them good equipment and assistants, and then leave them alone. This view arises in part as a protest against the continental tradition of the *Herr Geheimrat,* the professor directing his students, the master his disciples.

Many scientists conceive of leadership in this either/or manner, and do not recognize the existence of a middle ground between domination and isolation. Does such a middle ground of scientific leadership exist, and, if so, how does it affect performance as compared with the extremes?

In the following analyses, measures of supervisory behavior were obtained from the average reports of two or more subordinates. This procedure helps to guard against the possibility that the supervisor is simply adjusting his methods of leadership to the abilities of a particular subordinate.

In this section we shall deal with "small working groups"—two or more investigators who name the same person as their immediate chief. (In terms of the administrative structure, such a group might consist of a unit, a section, or even a small laboratory.)

A major supervisory variable we attempted to measure may be called independence or autonomy from the chief. Two items were used: (1) the percentage of scientists in each group who report that in selecting work problems or in interpreting results they

make their *own decisions;* (2) the extent to which they feel the chief's activities and decisions can *influence their work.* With these two items, four patterns of leadership were defined, ranging from "dependence" (subordinates make few decisions, and the chief has considerable influence) to "independence" (subordinates make many decisions on their own, and the chief has little influence). The intermediate categories were "mutual influence" (both subordinates and the chief have much to say) and "separation" (neither subordinates nor the chief have much to say—apparently decisions depend on the nature of the task or on higher chiefs).

The results (not illustrated here) show that performance is slightly higher under an intermediate degree of independence, rather than under full dependence or full independence. Junior scientists (civil service grades GS–9 and GS–11) benefit somewhat more from "mutual influence" between chief and subordinates; senior scientists (GS grades 12 and up) benefit somewhat more from "separation."

It seems plausible that too much independence may deprive the subordinate of the stimulation that a competent chief can provide. On the other hand, too close dependence on the chief may stifle individual initiative. By this line of reasoning, highest performance should result if we can combine the benefits of frequent stimulation with the assurance of freedom for initiative. To test this hypothesis we analyzed not only independence but also amount of contact with the chief.

The results in Figure 5 support the hypothesis that at the junior level, performance is highest when independence from the chief is combined with frequent contact with him—when the individual has frequent interaction with the chief, but also has considerable voice in the final decisions. A similar but less striking tendency exists for senior-level scientists (data not shown).

LEADERSHIP FACTORS IN THE LABORATORY CHIEF

The final set of analyses to be reported were conducted by Howard Baumgartel.[9] Studies in industry have indicated that a

[9]H. Baumgartel, "Leadership, Motivation and Attitudes in Twenty Research Laboratories" (unpublished doctor's dissertation, University of Michigan, 1955);

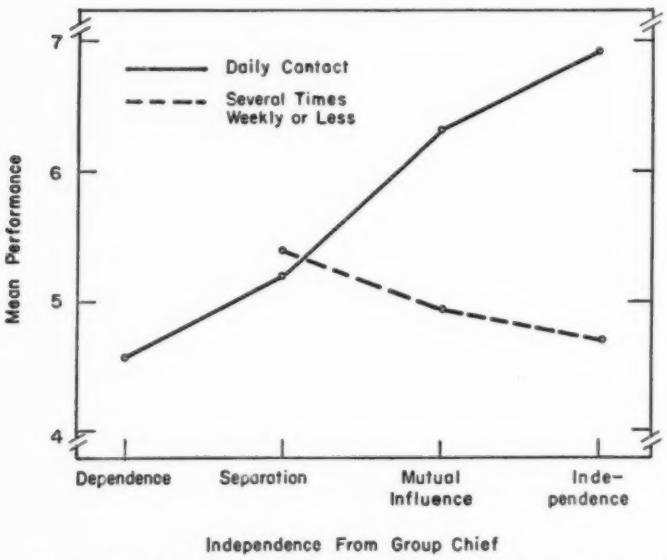

Figure 5. Scientific performance related to independence from group chief and to contact with chief (at junior level).

department head can influence the productivity and morale of employees at several levels under him. Does the same hold true in a research organization? To study this question, Baumgartel analyzed certain measures of the chiefs of twenty laboratories. The latter were basic administrative units ranging in size from six to thirty-three professional investigators, and as many sub-professional assistants. A typical laboratory was subdivided into three or four sections.

For this analysis it was not possible to use the measure of individual performance as a criterion, since the measure was originally obtained in part by comparing individuals with others in the same laboratory, thus reducing interlaboratory differences. But we have seen above that questionnaire items such as science-

"Leadership, Motivation and Attitudes in Twenty Research Laboratories" (paper read at American Sociological Society meetings, 1955); and Leadership, Motivations, and Attitudes in Research Laboratories, *Journal of Social Issues,* 12 (1956), no. 2 (in press).

oriented values do relate to performance; these and other attitude items were therefore used as criteria.

Baumgartel developed three measures of the laboratory chief. One was an index of the chief's "scientific performance and motivation," based on several intercorrelated items including his own score on performance and his motivation toward the science values. This index measures the extent to which a chief combines both high technical qualifications and strong motivation toward scientific goals.

A second index described patterns of supervision and was similar to the variable of "independence" discussed above. (The latter, in fact, was suggested by Baumgartel's analysis.) Examination of several items revealed three clusters or types: a "directive" type (characterized by high influence by the chief, little freedom for subordinates to make decisions, and moderate frequency of contact between them); a "participatory" type (high influence by the chief plus considerable freedom for subordinates, and frequent contact); and a "laissez-faire" pattern (little contact, little influence by the chief, and considerable freedom of decision by subordinates).

A third leadership factor was the extent to which the leader's actual methods of making decisions corresponded to the methods preferred by his subordinates. The discrepancy between these two measures constituted an index of "role conformity."

It was predicted that subordinates' motivations toward science values, their sense of progress toward these values, and their attitudes toward leadership would be higher under (a) chiefs with a high index of performance-and-motivation in comparison to a low index; (b) chiefs who used participatory leadership in comparison to those using directive; (c) chiefs who used participatory leadership in comparison to laissez-faire; (d) chiefs who conformed to the role expectations of subordinates in comparison to those not conforming.

A summary of results is given in Table 1. A "positive" relationship is one which conforms to the prediction; a "negative" relationship is one showing no difference, or a difference opposite to prediction.

Of forty-five tests where the direction of relationship was predicted, forty are positive, and sixteen of these are statistically

Table 1. Measures of scientists' motivations and attitudes related to factors in laboratory chief's leadership.*

Measures from scientists	Leadership factors			
	Performance-and-motivation	Partic., not directive	Partic., not laissez-faire	Role conformity
Science motivations (based on 4 measures)				
Significantly positive	3	1	0	No differences expected
Positive	1	2	3	
Negative	0	1	1	
Sense of progress toward scientific goals (based on 3 measures)				
Significantly positive	2	1	0	No differences expected
Positive	1	2	3	
Negative	0	0	0	
Attitudes toward leadership (based on 8 measures)				
Significantly positive	No differences expected	3	3	3
Positive		5	2	5
Negative		0	3	0

*This table summarizes the results of forty-five tests of relationship between leadership factors and scientists' motives and attitudes. (Science motivations were measured in four ways; sense of progress in three ways; and attitudes toward leadership in eight ways.) It was predicted that these relationships would be positive. The table shows the number of tests in which the relationships were positive and negative. A "significantly positive" relationship is a difference in the predicted direction which is large enough to attain the .05 level of confidence (using a one-tailed t test).

significant at the 5-per-cent level of confidence (using a one-tailed test). Only five results are negative. Thus the data in general support the hypotheses.

Some specific features deserve attention. First, the laboratory chief's own index of performance-and-motivation is more significantly related to his subordinates' motivation and sense of progress than is his pattern of supervisory behavior. In this organization, successful leadership depends not simply on administrative skill but also depends heavily on the leader's personal qualifications and his own motivation toward the task.

Second, there is fairly clear evidence that participatory leadership is more effective than directive leadership (and also slightly better than the laissez-faire pattern).

SUMMARY

In a large government organization conducting basic medical research, the level of individuals' scientific performance is found to be higher under the following conditions:

(1) Strong personal emphasis placed upon science-oriented values of using one's abilities, having freedom to pursue original ideas, and making contributions to basic scientific knowledge;

(2) Frequent (daily) contact with several scientific colleagues who on the average have been employed in settings different from one's own, who stress values different from one's own, and who tend to work in scientific fields different from one's own;

(3) At the same time, frequent contact with at least one important colleague who has similar professional values;

(4) A chief and a major colleague one of whom is in the same scientific discipline and the other in a different one, rather than both similar or both dissimilar;

(5) A chief who gives neither complete autonomy nor excessive direction, but who frequently interacts with subordinates and who also gives them the opportunity to make their own decisions.

In addition to these findings on scientific performance, analyses of scientists' motivations and attitudes in twenty laboratories show that:

(6) Motivation and sense of progress toward scientific goals are stronger under laboratory chiefs who themselves are highly competent and motivated individuals;

(7) Motivations and attitudes also tend to be stronger under laboratory chiefs who employ participatory rather than directive or laissez-faire leadership.

To summarize these findings in a few words, it appears that many scientists may benefit from (a) close colleagues who represent a *variety* of values, experiences, and disciplines, and (b) supervisors who avoid both isolation and domination and who provide frequent stimulation combined with autonomy of action.

John L. Kennedy
G. H. Putt

Administration of Research in a Research Corporation

The authors discuss some organizational problems of the new research corporation from the point of view of an administrator and a researcher. A tool for improving communication between them is described, and its use in planning a large-scale research program is outlined. G. H. Putt is research administrator and J. L. Kennedy is head of the Psychology Research Department at The RAND Corporation, Santa Monica, California, a nonprofit organization engaged in research for the United States Air Force and Atomic Energy Commission.[1]

THIS paper is the result of an attempt to pool the experiences and attitudes of a research administrator and those of a researcher in order to describe some frequently encountered administrative problems of the new "research corporation" and to suggest a way of alleviating one of these problems, namely, communication between research administrators and researchers.

Although little general agreement exists as to what kinds of human behavior constitute research, a great deal of it is being done and a substantial amount of money is being spent in support of it. In some quarters, research is practically equated to living, in the sense that all living organisms must conduct inves-

[1]This paper has been identified as P-847 in the RAND series.

tigations on the physical environment and on the behavior of other living organisms in order to stay alive. The purpose of such investigations is to predict and, by one's own behavior, to control the physical and cultural environments. In this sense, every living organism is a researcher and, specifically, all human behavior is research.

Mankind's development of science and the scientific method, however, have created a set of descriptive categories with which we now like to think about research. We have observed over the ages that a few people are driven to ask questions of nature or of the behavior of other living organisms that go far beyond the kind of observations that other people make in the normal course of living. We call this kind of behavior "basic" research as opposed to "applied" research. Applied research recognizes the constraint of time or timeliness for the solution of a current problem, while basic research is relatively timeless. Both formal varieties of research require design and application of special tools or methods in specialized institutions such as libraries, laboratories, universities, institutes, and corporations. The research corporation is one of the most recent institutional innovations. Because it is new and relatively untried as an institution, the research-corporation way of institutionalizing the research function is of particular interest and should be the subject of study in its own right, even though we have relatively few examples to investigate.

Why do we now have research corporations? What are the motivations of people who are willing to work in an untried institutional format? What kinds of people now work in such an environment? Where do they come from and where do they go? What do they produce and how can they be administered to produce most effectively? Are the problems of administering a research corporation different in any way from those of administering a university, a large business, or a research laboratory? These are questions on which little quantitative information is available. In order to study them, one conducts research of the more primitive type, with the primary tool of participant observation.

It seems to us that research corporations may have emerged for two interrelated reasons: (a) It is possible that research in the

universities and industrial laboratories has become narrowly specialized and increasingly out of touch with the larger needs of society for solution of the complex managerial problems produced by the rapid growth of technology since World War II. (b) It may be that a new willingness has emerged to try the methods of science and technology in areas heretofore considered to be in the realm of the executive, the manager, and the policy maker.

A trend toward specialization of output almost inevitably produces a counterreaction to find a mechanism for integration. So the research corporation appears to be a reaction to overspecialization. If it is true that the research corporation is a mechanism for integration of diverse specialized knowledge, one may ask what unusual techniques it has developed to perform this function. One answer seems to be the emergence of the interdisciplinary research team, or at least of an attempt to pool or mass brain power from a variety of traditional disciplines. It is here that the administrator of the new research corporation encounters his most difficult problems. Here lies the uniqueness of the research corporation when compared with the university, the industrial or government research laboratory, or the research institute.

The interdisciplinary-team solution to the cry for integration seems simple and straightforward on the surface, but in it is a Pandora's box of unsolved administrative problems involving human motivations, traditions, habits, expectations—in a word, culture. Every new organizational form runs up against cultural lags, deep-seated traditions, and well-entrenched conservatism. The research administrator who embarks on a research venture involving the interdisciplinary team should weigh carefully the cultural costs of integration. This paper will attempt to describe some of the problems associated with the interdisciplinary solution. It will also describe a tool or method that the authors believe will assist interdisciplinary teams in carrying out the integrative function and will improve communication between administrators and administered.

SEARCH, RESEARCH, AND DEVELOPMENT

One of the first observations to be made about the various separate disciplines of science and technology is that each has built

up its own framework or culture represented by preferred ways of looking at the world, preferred methodology and preferred terminology, preferred ways of presenting results, and preferred ways of acting. These preferences run deep—they are inculcated as possibly the most important aspect of undergraduate and graduate training. To be an engineer is not only a matter of learning some substance and some methodolgy but also a matter of learning to prefer certain kinds of information about the world and to prefer certain methods for utilizing this information. A study of the transmission of the culture that defines the words engineer, physicist, sociologist, and mathematician is really a study of the history of science and technology. The "natural philosopher," when science was new, was the "generalist"—a whole interdisciplinary team wrapped up in a single nervous system. Benjamin Franklin was at least a physicist, a philospher, an engineer, and a diplomat. The natural philosophers were men unhampered by the accumulated culture of science. They built their own frameworks for understanding the world. They were primarily engaged in "search" as opposed to research. They developed ways of discovering *how to think about problems* as opposed to getting answers to questions posed within an established or traditional framework. Searching appears to be the traditional function of the philosopher. With the sharp line drawn in modern times between philosophy and science, *searching* for the better framework in science seems to be confined to the very few philosophers of science and technology—the many do *research*.

Research has come to be as ritualistic as the worship of a primitive tribe, and each established discipline has its own ritual. As long as the administrator operates within the rituals of the various disciplines, he is relatively safe. But let him challenge the adequacy of ritualistic behavior and he is in hot water with everyone.

The first conviction of the research specialist is that a problem can be factored in such a way that his particular specialty is the only important aspect. If he has difficulty in making this assumption, he will try to redefine the problem in such a way that he can stay within the boundaries of his ritual. If all else fails, he will argue that the problem is not "appropriate." Research specialists,

like all other living organisms, will go to great lengths to maintain a comfortable position. Having invested much time and energy in becoming specialists in a given methodology, they can be expected to resist efforts to expand the boundaries of the methodology or to warp the methodology into an unfamiliar framework.

Thus an unsolved problem for the administrator of research in a research corporation is how to induce the members of his interdisciplinary teams to indulge in *search* for the adequate framework rather than *research*. Research tends to yield a set of unintegrated answers on components of the problem. The integration demanded by the problem must then be done by research administrators and directors, using the best framework available—usually the administrator's own private framework. Again, no one is satisfied. The administrator is unhappy because he usually recognizes that his framework is not the best possible one—and the research specialists are unhappy because their individual contributions are often distorted and unrecognizable. Frameworks are most difficult to communicate because one quickly runs into fundamental philosophical and cultural issues.

The fact that individual contributions tend to be distorted or to disappear in a larger framework also is an unsolved problem for the administrator. Our research culture is based upon reward to the individual, not to the team. The perceptive research specialist knows this fact of life perfectly well; hence the interdisciplinary team is unstable on at least two counts: the sweat, blood, and tears of trying to resolve conflicting values and the problem of reward to individual members. The appropriate expectation for interdisciplinary teams appears to be that they will be unstable associations. But it is precisely interdisciplinary search behavior that the research corporation administrator needs and should insist upon. Research can be done by the individual specialist, once the framework has been established, although certain large problems will require continued close cooperation during the research and development phases.

Development, the process of putting research results into practice, also requires a framework, but here the problem is not search or research but the acceptance of a framework established by

search and research. The research specialist who enters the field of development should recognize the existence of a framework and expect to behave in accordance with it, to be constrained by it, and be required to support it. The argument that search and research specialists should not enter the development field because of these constraints is rather attractive in the abstract, but the individual rewards for doing so will continue to attract search- and research-oriented people. The problem for the development administrator is to communicate the framework effectively and to insist upon at least a minimum acceptance. When development programs regress to a basal stage in which the framework obtained from search and research is continually under scrutiny, little development work gets done.

THE INTERDISCIPLINARY PROBLEM

We have now established the need for a search procedure, device, or method which will perform the following functions:

(1) Provide a framework within which research administrators and research specialists may interact and make decisions about what research should be performed and how research should be carried out in order to answer the large, complex, interdisciplinary problems of "real life."

(2) Provide a framework for effective communication with persons engaged in development. The primary problem that such a tool should help to solve is that of communication between research administrator and researcher and between researcher and developer.

As a participant observer in two major interdisciplinary-team efforts over the past five years, one of the writers is now quite familiar with two rather different approaches to the interdisciplinary problem.

The first approach may be described as the "brute force" or "common enemy" technique, in which the interdisciplinary team picks a relatively unexplored area, such as organizational behavior, for its activities and "lets the problem be the boss." Thus in the first of the above-mentioned team efforts the scientific framework was postponed, and decisions were coerced by choosing first to put a large, interacting man-machine system into a laboratory

so that it could be thoroughly observed. The scientific framework or model emerged *after* the experiments had been completed. The observations carried out in the laboratory were made for the purpose of establishing a framework, which then made possible decisions regarding what research should be conducted and how it should be conducted. This team, then, set out to observe a complex phenomenon in ways that would lead to a scientific framework.

The serious administrative problem with search activities carried on in this way is that the team may be apparently unproductive for a long time. Unless the research administrator completely understands that search rather than research is going on, he will tend to apply inappropriate criteria to the work. The obvious solution to this communication problem appears to be to include membership from research administration on the search team in such a way that the uncertainties, communication problems, and value impasses may be directly experienced and progress assessed from the administrator's point of view. Much of searching is not publishable in standard research journals, nor is it of great interest to those not engaged in the process. It is tentative, rapidly changing, full of sudden insights and long fallow periods, unpredictable, and unpopular with colleagues engaged in exploiting more traditional frameworks by more traditional techniques. But search is the lifeblood of a research corporation, because new tools come from new frameworks. Specifically, the new tools for the solution of complex system problems will come from the searching of interdisciplinary teams if we can find a way to stimulate and reinforce the team concept.

The second interdisciplinary team had a quite different way of operating. Here the time and facilities were sharply limited and the interdisciplinary framework was the initial focus of attention. The team was fortunate in discovering a problem on which previous observation and research had already accumulated much factual information. The problem of this interdisciplinary team was to try to fit the information together into a coherent context from which decisions for future research could be made. It attempted to solve the interdisciplinary communication problem by constructing a "contextual map." Before discussing the map we shall first give some indication of the team's problem.

During a recent leave of absence which was spent at the Center for Advanced Study in the Behavioral Sciences, Kennedy worked closely for a year with a political scientist (Harold D. Lasswell of the Yale Law School), an economist (C. E. Lindblom, Department of Economics, Yale University), and an anthropologist (Allan Holmberg, Department of Sociology and Anthropology, Cornell University). The problem—chosen because of its ramifications in anthropology, economics, political science, and psychology—was to plan a ten-year program of rapid cultural and technological change in an underdeveloped region.

The region was an inter-Andean valley, the Callejón de Huylas, in north-central Peru, where Holmberg, the anthropologist, had been operating the Hacienda Vicos, rented by Cornell University from the Peruvian government, as a laboratory for the study of cultural change.

Hacienda Vicos is on the western slope of the Cordillera Blanca (the "White Andes") at an altitude of about 9,000 feet. The land, which is some 22,000 acres in extent, ranges from a few acres of rather fertile river bottom through arable uplands to many acres of high mountain land suitable only for grazing. About 2,500 Indians live on the hacienda. They own none of the land, but work it for the hacienda management and their own subsistence. By long-standing custom, Indian families provide the work of one member three days a week to the hacienda management in return for the right to use some of the land. The land is thus parceled out between the hacienda management and the Indians. Because of this way of renting the land, managements come and go, but the Indians remain on the land, living out their life cycle in almost complete isolation from modern coastal Peru and the outside world.

The Indians, the land, and the hacienda management make the region a complex interacting cultural system into which the Peruvian government, Peruvian entrepreneurs, and outside capital are introducing modern technology. For example, a large hydroelectric project being built some fifty miles from the hacienda with French capital is expected to provide electricity for the whole Callejón de Huylas within a few years. Roads are being improved, trucks are coming into the valley, and communications are being established with the coast.

The Peruvian government recognizes that the hacienda, an anachronism in the modern world, must go. But what will replace it?

The Indians who constitute about 70 per cent of the population of Peru, are not ready for modern technology—either culturally or politically. To avoid the extremes of revolution on the one hand and race extinction on the other, plans were made to carry the Indians of Hacienda Vicos from feudalism to political and cultural participation in modern Peruvian life in the relatively short time of ten years. To do this, planned experiences, or "interventions," were started in 1951. These interventions are the independent variables of this experiment in cultural change; the resulting changes in behavior are the dependent variables.

THE CONTEXTUAL MAP

The interdisciplinary team which we have just discussed was faced with the complexities of a large interacting cultural system and its own problems of internal communication. A method was needed for systematically utilizing the talents of the team members despite the frustrations of having to establish a common vocabulary, an agreed-upon ideology, a set of reasonable goals, a common context for symbols, and ways of translating ideas into actions. The solution hit upon was to design and make up a "map room," whose walls contained a large matrix with the time (in years) on the ordinate and with the "variables" the group was interested in along the abscissa. This matrix was the "contextual map."

Since the team began with some 250 variables, room space was soon exhausted. The map that was finally used had 130 variables, grouped under "government," "economics," "social relations," "education and mass media," "health and welfare," and "attitudes." There were spaces for three-by-five cards for each of ten years under each variable. The entire matrix thus could hold 1,300 cards that summarized the value of the variable in the past or described its desired value for the future. At the top of each column was a description of the value of the variable "in the best of all possible worlds" and a statement of the value anticipated or desired at the end of the ten-year experimental period (1951–1961).

Since the group was working in 1954–1955, and the ten-year map extended back to 1951, it was necessary to work back to the bottom of the map. From a thorough base-line study of the community, an estimate of the 1951 value of each variable was obtained and, from a second study, descriptions of past interventions and values of the variables were established. These were placed in the proper time sequence. As an example, the column for the variable "number of required school years" under the group heading "education and mass media" looked like this:

Ideology or Goal—Demand for skill in scientific outlook and in the scientific method

1961	Status	Compulsory grammar school education (eight years) for all.
1955	Status	Over 100 students have had more than two continuous years of education. Housing facilities available for seven teachers at hacienda.
1954	Intervention	Second school building finished, including auditorium. Special teacher from U.S. worked with Indian children on arts and crafts for three months.
	Status	Pre-industrial school with seven teachers supplied by ministry of education.
1953	Intervention	First building of new school finished. Primary school inaugurated and turned over to Peruvian government.
	Status	123 of 350 eligible students of both sexes getting some schooling; two teachers.
1952	Intervention	Land prepared for construction of new school. School lunch program initiated, with balanced menus prepared by Home Demonstration Unit, Ministry of Agriculture.
	Status	One teacher, 40 pupils.
1951	Status	Two years of primary school for less than 5 per cent of eligible children.

The Map as a Group Memory

One of the main difficulties in programming and planning is the need to deal with large numbers of interacting variables. Programs of any degree of complexity strain human memory. The

contextual map records past decisions and actions as well as predictions and anticipated reactions for the future. The map is a way of keeping "minutes" in a context of the past so that the relevance of decisions is immediately apparent. Each member of the group can refresh his memory for a meeting by "reading" the minutes in this context.

The map room contained a conference table and chairs so that decision-making and planning conferences could be held there. Thus the group was continually confronted with the developing map and the members were constantly aware of gaps in the information and suggested priorities for items to be considered.

The map was a large, living memory for the group. As the decision-making conferences went on, each member of the group begin writing three-by-five cards and coding them for their proper place on the map—a letter and number on the original card told the secretary where to post the duplicate card she typed up. By the next meeting, the cards would be posted and the members of the group could refresh their memories of previous discussions by referring to the map.

Reinforcement

A common characteristic of planning and decision making is the lack of a tangible product. There is little motivation for people to take part in these activities because they get so little reinforcement. Using a contextual map gives two kinds of reinforcement. There is a "product"—the developments on the map —and a prediction reinforcement. The prediction reinforcement takes place over a period of time, since the map continuously compares the predicted status of the variables with their actual status. Systematic comparisons of predictions with the actual events make it possible to improve the prediction methods used by the group.

Communication

One of the best features of this kind of display is the ease of duplicating it. The position coding of the cards makes it possible to put up duplicate maps in many places at once—and this can be done with the whole map or with pertinent sections of it.

The cards can easily be carried or mailed in a small card file and set up in a new matrix in a short time. For example, the map used at the Center was set up for the field staff of the project at Hacienda Vicos in about half a day.

Because of its portability and ease of duplication, the contextual map is a useful briefing device. At the Center it was found possible to get the essential nature of the project across by taking new people into the map room for a briefing and allowing them to wander through the project by reading the cards. The map could even be photographed and made into slides that could be projected on a screen during a briefing.

Remarks

The map room is, in one sense, a "learning machine." The parts of the machine that do the thinking and adapting involved in learning are, of course, men—the planners. But they are aided by a display that responds to the issues before it by making the complete context of the decisions readily available and by quickly assimilating current information, decisions, and predictions.

There is nothing magical about this technique. Man, as always, solves the problems. But man's talent for planning can be greatly increased if he has better tools to work with—if the men who make the plans are given ways of combining ideas into understandable formulations they can employ systematically.

Having said this, we can point out the unsolved problems in this method of planning. Since this technique, like any other, is only as good as the ideas that go into it, the best information must be made available and competent talent must be employed. Men with relevant experience and appropriate talent need to explore the domain of the project step-by-step and lay out the problem in several dimensions—in the Hacienda Vicos example given above these dimensions were time and cultural conditions. This requires improvement in internal communications—a difficult problem in most planning projects but one in which the map technique may prove useful. If the problem is approached in this way, immediate questions and appropriate "interventions" can be identified and acted on, and decisions can be recorded so that their consequences can be checked in the future.

Further technical development of the map is necessary, of course. A more effective way of storing, manipulating, and displaying large quantities of information about goals, predictions, and past, present, and future conditions is needed. For this we can look to high-speed data-handling equipment and the many recent developments in displaying information electronically. An ideal map, for example, might give the decision-making group a listing of all relevant variables, in order of priority, before each decision.

The design of the map room itself is a fascinating problem. Obviously the size of the room should not limit the extent of the map. What seems to be needed is a large room that can be made into different-sized smaller rooms with theater flats and temporary partitions. With the proper use of space many decision-making groups should be able to use a number of maps simultaneously in the same general area.

The contextual-map method is obviously still in a low state of development. But because of its facility for display, communication, memory, and reinforcement, it promises distinct and unique advantages in formulating, monitoring, and managing interdisciplinary search programs.

Finally, the contextual map should not be confused with the scheduling boards commonly used in the control of development programs or in the control of industrial processes. The contextual map is a technique for *finding* a framework. The scheduling board is a way of exploiting a framework. Both techniques use large displays and may exhibit time as one of the axes of the matrix, so that, in end product, they may look quite similar. But the contextual map attempts to organize information into new and more meaningful categories, whereas the schedule board merely exhibits the consequences of adopting a framework.

CONCLUSION

The research administrator may now ask, "Which of these modes of operation is preferable, framework first and then research, or search-framework-research?" The answer seems to be that such decisions depend upon many factors. It should be noted that the Peru group was completely dependent on five years of field observation and investigation for the information about the

context of Hacienda Vicos it used in constructing a contextual map. The organizational-behavior team also required a large investment of time, money, and energy to collect the information it needed to proceed with the construction of a theoretical model.

No amount of administrative wishing will circumvent the requirement for the collection of much information about complex problems before the new framework can emerge. Individual administrative preference is about the only tool that can be applied to the decision as to how the experience should be gained—whether in direct contact with the phenomenon in laboratory and field installations or through the secondary sources of the study of documents, journals, histories, and other compilations of accumulated wisdom.

The research administrator can insist, however, that interdisciplinary searching be carried out in a communicable, systematic manner and that it have a product, such as the contextual map. He will improve communication between administrator and the search team by finding ways of "joining the team," thus injecting his attitudes, information, and values into the interdisciplinary product, a framework within which specialized research can proceed with some confidence that the results will at least be relevant to the problem.

Clovis Shepherd

Paula Brown

Status, Prestige, and Esteem in a Research Organization

This article analyzes the system of stratification in a naval research and development laboratory, using questionnaire data provided by laboratory personnel. Seven major status groups were identified and their relative prestige examined. The relationships of background factors, behavior and attitudes, and esteem to status were then analyzed. Finally the interrelationships of esteem variables were explored.

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A RESEARCH organization is in a rather difficult position with respect to various administrative problems. Creativity is essential to success, but how can it be measured or assessed? Often an administrator is forced to use only an after-the-fact evaluation, because of the difficulties in evaluating progress toward a solution. The result is that a great deal of evaluation must be done by the

[1]This is a part of a study carried out by members of the Human Relations Research Group, Institute of Industrial Relations, University of California, Los Angeles, under a grant from the United States Office of Naval Research. The authors were members of the group at the time of this study. The group is headed by Dr. Robert Tannenbaum.

individual researcher, and the administrator often has to rely heavily on the individual's self-evaluation.[2] This encourages in the researcher an independent attitude, a high value on individual initiative, and a resistance to rigid controls.

Complicating the picture is the general status of the researcher. He is a professional scientist or engineer with extensive education, and his training has encouraged an independent outlook. He is accorded high prestige in the community, but he may have only a comfortable income. His self-picture may include a mildly superior attitude toward nonresearchers, for he may feel that he is particularly objective and realistic. On the other hand, he may also have an idealistic attitude toward life, which at times may appear rather naïve to "men of practical concerns."

These and other discrepancies lead to a dilemma in the researcher's behavior. He is deeply committed to "hard, cold facts," to objective reality, and to the scientific method. He wants to believe that all his behavior is rational. Yet certain aspects of his social status and role and of his "occupational personality" make him vulnerable to various strains and anxieties. Like most human beings, he establishes close interpersonal relations in his work organization, and these have varying effects on his behavior. But he may be prone to deny the influence of interpersonal relations and emotional feelings on his job behavior.

A research organization of any size is likely to require men with a variety of skills. These occupational groups are differentiated and stratified within the society, since occupation is a key criterion of our system of stratification.[3] They are also differentiated and stratified within a research organization. In addition such distinctions as income and authority, "importance" to the organization, and type of work help make the status system a complex one.

The organization is composed of a number of small work groups, which must be coordinated in varying degrees. In addi-

[2]See Irving R. Weschler and Paula Brown, eds., *Evaluating Research and Development* (Los Angeles: Human Relations Research Group, Institute of Industrial Relations, University of California, 1953).

[3]See Talcott Parsons, "A Revised Analytic Approach to the Theory of Social Stratification," in Reinhard Bendix and S. M. Lipset, *Class, Status and Power* (Glencoe, Ill., 1953).

tion various friendship groups and cliques arise which may be only indirectly related to the structure and goals of the organization.

Thus stratification and differentiation in an organization display similarities to and differences from that in society, the community, and the small group.[4] The segmental and circumscribed nature of some interaction tends to produce rational ("thinking") behavior, but at the same time intimate interpersonal interaction tends to produce nonrational ("feeling") behavior.

PURPOSE OF STUDY

Our purpose in this study is to examine certain aspects of the system of stratification in a research organization. The point of departure is the *status-role* point of view in which attention is focused upon the positions or offices in an organization and the individuals who occupy these positions. The "cultural-institutional"[5] point of view is touched upon slightly, primarily to provide a context for interpretation, but it occupies a secondary role in the analysis as a whole.

In the status-role point of view,[6] a basic distinction is made between a *position* (office) and a *person* occupying a position. *Status* will be used here to denote a number of positions which have broadly similar rights, duties, and expected behavior. Statuses may be ranked on the basis of various criteria, thus forming a system of stratification. The evaluation of a status is usually called *prestige*, in order to distinguish such evaluation of the status from the requirements of that status. *Role* refers to the way in which a person carries out a status or performs the tasks expected of him. Similarly, *esteem* refers to an evaluation of the role behavior of a person.

[4]A large organization often resembles a community in size and complexity. A number of studies have shown, however, that organizations or organizational subgroups perform many of the functions of small groups. See F. J. Roethlisberger and W. J. Dickson, *Management and the Worker* (Cambridge, Mass., 1939); P. M. Blau, *The Dynamics of Bureaucracy* (Chicago, 1955); A. W. Gouldner, *Patterns of Industrial Bureaucracy* (Glencoe, Ill., 1955); and G. C. Homans, Status among Clerical Workers, *Human Organization*, 12 (1953), 5–10.

[5]See Talcott Parsons, Suggestions for a Sociological Approach to the Theory of Organizations—I, *Administrative Science Quarterly*, 1 (June 1956), 63–85.

[6]The following definitions and point of view are largely those of Kingsley Davis, *Human Society* (New York, 1949), esp. pp. 83–97.

Any individual entering an organization comes to it with certain background characteristics, such as age, education, and experience. These factors contribute to his skills, attitudes, and expectations. His job and its requirements, plus the interpersonal relations he has at work, may alter or reinforce these skills, attitudes, and expectations. His occupation, however, is the major factor determining the type of work he will do, what he expects and what others expect of him, and the type of person with whom he will interact. Broadly speaking, the theoretical point of view taken here is that occupation is the independent or causal variable, and participation, mobility, ranking of prestige and esteem items, personal goal orientation, and esteem are the dependent or effect variables.

PROCEDURE

The organization under analysis is a research and development laboratory.[7] Its major purposes or goals are to pursue basic and applied research in various areas of interest to the United States Navy, and to engage in developmental work and testing on certain naval equipment. Almost all employees at the time of the study were under civil service. Though the organization is a part of a larger organization,[8] its separate location and administrative policy have given it a great deal of autonomy.

The organization is more a functional than a line or staff-line type,[9] owing to the nature of its work and the need for flexibility in working arrangements. The production of "goods" is minimal, and the "worker" base is quite small relative to "management."

The department to be discussed is composed of two staff offices and five divisions. Each division contains several branches, most

[7]This organization has been described in some detail elsewhere. See P. Brown, Bureaucracy in a Government Laboratory, *Social Forces*, 32 (March 1954), 259–268; and P. Brown and C. Shepherd, Factionalism and Organizational Change in a Research Laboratory, *Social Problems*, 3 (April 1956), 235–243. Throughout this paper, "laboratory," "organization," and "department" will be used interchangeably. Although the organization has undergone a number of changes in structure and function since our study, the present tense will be used in this article, but it should be understood that all comments refer to the period of investigation and not necessarily to the present situation.

[8]It is one department of a naval station.

[9]See Wilbert E. Moore, *Industrial Relations and the Social Order* (New York, 1951), esp. pp. 71–84.

of which are divided into two or more sections. Each of these units has a head, and the heads of higher-level units also have administrative and clerical assistants. The staff units are small and composed of editorial and administrative assistants and clerical personnel.

The five divisions have somewhat different functions. One division is devoted to research, another to assessment, and three are concerned with the development of naval equipment. These differences in function are not mutually exclusive, however. Consequently, the differences between divisions are largely differences in the emphasis placed on one or another of these functions.

A questionnaire was administered to all personnel in a period of a few days.[10] A total of 307 were returned, representing about 85 per cent of the total.[11] Data were gathered on occupation, age, education, experience, authority, participation, mobility, ranking of prestige and esteem criteria, personal goals, and preference choices on a number of criteria. The returned questionnaires varied somewhat in the degree to which they were completed. In general, the sociometric sections were often incomplete; the questions on ranking of prestige and esteem criteria and those on personal goals were answered by most respondents; and all other questions were answered by nearly all respondents. Between thirty and fifty minutes were required to complete the questionnaire.

STATUS GROUPS

Since occupation is a key criterion of status, it is the major factor used to differentiate status groups. Job titles are not used because the members of the organization feel that distinctions between many of them (e.g., between chemical engineer and electrical engineer) are of no importance in determining status or prestige. These job titles are rarely known and frequently change. On the other hand, an individual's occupational category is usually known, and a change in occupational classification is very rare. In addition a number of other factors are taken into account:

[10]We would like to thank all members of the department for their cooperation in working with our group.

[11]The nonrespondents included persons on leave, at other locations and inaccessible, or engaged in pressing work at the time.

the prestige of the occupation in the country as a whole, income, civil service classifications and grades, and the attitudes toward these occupations expressed by the members of the organization. These considerations allowed us to establish status groups and to arrange them in a prestige hierarchy.

Per-diem employees (paid by the day on an hourly wage basis) are skilled and semiskilled workers. As a group, they are distinct from all other employees owing to their types of work and conditions of employment. They are also the lowest group in the prestige hierarchy. There are twenty-nine persons in this group.

Per-annum employees (paid by the month on an annual basis) are differentiated from one another by occupational categories and by government service (GS) grades, ranging from GS–2 to GS–15. The occupational categories are professional, administrative, subprofessional, and clerical. The thirty-six clerical workers, limited to GS–2 to GS–5, have less average income than the per-diem employees, but their white-collar standing and other factors place them slightly above the latter in prestige. The fifty-five subprofessionals, who are technical workers such as engineering aides, laboratory mechanics, and draftsmen, range from GS–2 to GS–11, with the median and mode at GS–7. They have more prestige than the clerical workers. The twelve administrators—administrative or editorial assistants to higher level supervisors (staff officers)—range from GS–7 to GS–13, with the median at GS–9. They overlap the subprofessionals and professionals in grade and income, but their prestige is intermediate.

The one hundred seventy-five professional scientists and engineers have the highest starting salary and most of the positions of authority in the organization. Though they are a fairly homogeneous occupational group, gradations from GS–5 to GS–15 reflect important differences in income, authority, and prestige. The twenty-four low professionals, GS–5 and GS–7, are, in general, young and inexperienced, and they advance fairly rapidly into the mid-group. The seventy-eight mid-professionals, GS–9 and GS–11, form the body of independently working professionals. The seventy-three high professionals, GS–12 to GS–15, are the more advanced independent workers and supervisors of all levels.

A brief and oversimplified picture of these status groups may

help to highlight their activities and differences. The high professionals supervise work and make policy decisions—they decide what is to be done and who is to do it. The mid-professionals work independently on assigned projects—they decide what is needed and how it is to be done. The low professionals are apprentices—they help the mid-professionals. The administrators take care of some administrative work as delegated by the high professionals and serve as staff advisors on administrative matters. The subprofessionals perform various technical jobs such as mathematical and statistical calculations, working drawings, and model construction, for the mid-professionals. The per-diem employees construct test models and carry out tests. Finally, the clerical workers do office work for the high professionals and administrators.

BACKGROUND CHARACTERISTICS

Paralleling findings in other studies,[12] average age varies with status groups. The youngest groups are the low and mid-professionals and the clerical workers. The subprofessionals, per-diems, and high professionals are considerably older. The administrators fall between these groups. These differences in age reflect the barriers between some of the statuses, which make shifts to a group of higher prestige on the basis of experience and seniority difficult if not impossible. Within each status group, however, the older employees generally have higher grades than do the younger members.

In a research and development laboratory, special technical knowledge is necessary for the accomplishment of the organizational goals.[13] Since a college education (or its equivalent) is one criterion for the classification of personnel as professional, the differences among the status groups are inherently very great.

[12]For example, see D. C. Miller and W. H. Form, *Industrial Sociology* (New York, 1951), p. 359. The authors state that the median ages for similar occupational groups are:

	Men	*Women*
Professionals and Semiprofessionals	38.7	33.4
Clerical	35.2	29.9
Craftsmen	41.4	37.2

[13]The high valuation placed on technical knowledge in a similar organization has been discussed in H. A. Shepard, The Value System of a University Research Group, *American Sociological Review*, 19 (Aug. 1954), 456–462.

No per-diem or clerical workers and only one subprofessional have a B.A. degree. Seventy-five per cent of the administrators, 87 per cent of the low professionals, 90 per cent of the mid-professionals, and 99 per cent of the high professionals have a B.A. or higher degree, and the percentages who have an M.A. or Ph.D. also increase with these status groups. Thus education and prestige are directly related.

In most organizations experience in the field and seniority in the organization bring promotions and positions of higher prestige. But when the criteria for advancement do not emphasize experience, there is no automatic rise in grade with seniority. Furthermore, the barriers between status groups in this organization place limits upon the advancement of many persons. The lower status groups (per-diem and subprofessional) have the greatest experience and seniority. Within the three professional groups, however, experience and prestige show a high correlation.

Income in the department is based upon grade and length of time at that grade. There are considerable differences in the rates of advancement and in ceilings for the various groups. Per-diem wages are subject to local rates for the type of job, while all per-annum salaries are based upon a national scale. A discrepancy between salary and status exists where the per-diem and subprofessional scales overlap.[14] Subprofessional classification indicates greater technical skill and white-collar work. A per-diem worker at the top of his scale, however, has a higher income than the lower level subprofessionals and he also has some additional benefits.

The clerical employees have the lowest ceiling of the per-annum employees. They and the subprofessionals have a slower rate of advancement. While subprofessionals and clerks rise through the GS grades one at a time, the administrative and professional scales are GS–5, 7, 9, and 11, then GS–12, 13, 14, 15. The professionals have the most rapid rate of advancement, although the rate is reduced as they rise in grade.

Another indication of differences among these occupational

[14]For a discussion of the monetary overlap of "blue-collar" and "white-collar" occupations and the consequences of this for stratification and motivation, see Miller and Form, *op. cit.*, esp. pp. 130–133 and 370–371.

groups is the per cent who hold positions of authority. Most of these positions are held by professionals. Occasionally, subprofessional draftsmen and statisticians are in charge of drafting and computing groups, but they never supervise professionals. Among the professionals certain positions of authority are associated with high GS grades, since an advance in authority often carries a grade rise as well. Some high GS grades, however, are held by technical specialists who have no supervisory authority.

Thus age, experience, education, and seniority are differentiated among the status groups; on the average, professionals are younger and more mobile than persons in other occupational groups. Though the clerical employees are also young, they have more experience in their field than do the low or mid-professionals, presumably because they begin to work in their field at an earlier age. Age, experience, and seniority are highly intercorrelated, and, owing to the occupational and educational barriers between some status groups, are unrelated to the prestige hierarchy of the status groups. Prestige of status groups is directly related only to education, though within each status group prestige of position is also directly related to age, experience, and seniority. Within the professional group, moreover, age, experience, and seniority are highly correlated with GS grade and authority.

In addition, as will be discussed later, seniority is also related to feelings of dissatisfaction, largely owing to the ceilings within the lower prestige groups which often place relatively young and inexperienced professionals in positions of authority over older and more experienced subprofessionals and per-diem workers.

BEHAVIOR AND ATTITUDES

The degree of participation of various status groups in community activities has often been noted.[15] The most general finding has been that the higher the class or prestige of individuals, the wider their range of acquaintances and the more they participate in community affairs. An analogous situation exists in this organization. Three types of participation in organizationally

[15]See W. L. Warner and associates, *Democracy in Jonesville* (New York, 1949); and H. Kaufman, *Prestige Classes in a New York Rural Community* (Cornell University Agricultural Experiment Station, Memoir 260; March 1944).

relevant activities were investigated. First, data on patterns of work relations and personal acquaintances partly parallel findings in community studies.[16] As prestige increases the number of personal acquaintances tends to increase. In community studies, however, one's personal acquaintances tend to be at the same class or prestige level, while our respondents often indicate their superiors as work partners and personal acquaintances. Clerical and per-diem workers are rarely mentioned, except by one another. This difference may reflect the higher salience of status and prestige in a research organization, as well as the patterns of work relations in an organization where a great deal of emphasis is placed on an individual's technical competence in a particular field rather than his social accessibility.

Second, data on activity on committees appointed by officials of the naval installation reflect the same prestige differentials,[17] though not as markedly, and also reflect the technical competence of members of status groups. In addition a status group interest is reflected. All status groups participate on committees, but there are differences in the types of committees on which they most frequently serve. The major types of committees are technical, administrative, training, employee welfare, philanthropic, and social. The high professionals are most active and serve on the widest variety of committees, though technical, training, and employee welfare are most frequently mentioned. The administrators are most active on training, administrative, and technical committees. Subprofessionals are usually found on employee-welfare committees, clerical workers on social, training, and employee welfare committees, and per-diem employees on training and employee welfare committees.

Third, data on professional or official contacts outside the organization reflect status and prestige differentials most markedly. The high and mid-professionals are far more active than any other group, in attending professional meetings, visiting other organizations for information or equipment, and publishing re-

[16]The questions were: "Name the people with whom you work most closely" and "Name the people whom you know best in [the department]."

[17]The respondents were asked to name the committees or special groups of which they had been members.

ports of work. This, of course, is usual with any organization—persons in high positions are those most likely to be concerned about and responsible for interorganizational relations.

Since education is so crucial for promotion in a research organization, mobility intention was measured by intention to work toward a higher degree. The group with the greatest mobility potential, the low professionals, have the highest percentage (over 50 per cent) who express an intention to work toward a higher degree. A somewhat lower percentage of mid-professionals and very few high professionals or members of other status groups indicate such an intention. The decrease in intention as prestige among professionals is increased may be due, in part, to the higher level of education already achieved and, in part, to the decrease in the salience of educational level for further promotion after one has reached a relatively high educational level and status position.

Some control over intention versus action was obtained by asking whether or not respondents had taken any courses related to their work during the immediately preceding year. Almost all respondents who intended to work toward a higher degree also had taken courses during the preceding year, and many persons who did not intend to work toward a higher degree or who were undecided had also taken courses during the previous year. This educational activity partly reflects organizational policy, since the organization offers a number of courses itself, and some of these are required of certain persons. Both intention and action as measured here provide further corroboration for the observation that the educational barrier between the professionals and others is rarely crossed. The subprofessionals and per-diem workers could achieve professional classification by acquiring more education, but their age and status seem to minimize the attractiveness of education as a channel of upward mobility.

Two other variables related to mobility were investigated: satisfaction, measured by whether a person would most like to have his present position or some similar position (satisfaction) or to have a higher level position or quite different position (dissatisfaction); and confidence, measured by the amount of confidence expressed in a person's ability to handle the position he held at that time (a five-step scale from "very much" to "not at all").

By and large, the lower prestige groups are the most confident, though within the professional group confidence increases with prestige. This may reflect both the circumscribed nature of the work and less responsibility at the lower prestige levels. About 70 per cent of the per-diem, clerical and subprofessional employees, 60 per cent of the high and mid-professionals, 42 per cent of the administrators, and 30 per cent of the low professionals express "very much" confidence.

Over 40 per cent of the high and mid-professionals, subprofessionals, and administrators, 36 per cent of the low professionals, and about 25 per cent of the clerical and per-diem employees express dissatisfaction with their present positions. The level of satisfaction of the low professionals may be largely a function of their anticipated upward mobility, while their low confidence may reflect their inexperience. The subprofessionals seem to be in a difficult position, as they are confident and dissatisfied. Because they are older and more experienced than most of the professionals, they may feel that they are capable of handling higher level positions. They seem to lack the motivation to increase their education and thus be able to achieve this goal, however.

Fifteen criteria of prestige and esteem were ranked by the respondents in reply to the question "What do you think should determine a person's importance in [the department]?" The rankings of each status group were combined and averaged.[18] The results show very high agreement on the importance of these items throughout the department. The more measurable items such as profession, supervision, professional contacts, grade, education, security clearance, and interests outside the department are considered relatively unimportant. The high-ranking items are, on the whole, the less tangible ones: knowledge, getting along with people, accomplishments, experience, and enthusiasm. Thus the members of the organization reject the criteria often used to measure prestige and stress qualities which reflect esteem factors —interpersonal relationships, personality, and peer evaluations.

Differences among the status groups show some interesting con-

[18]A pretest which used open-ended questions provided most of the items. The pretest responses were rephrased to fit into this format, and one or two items relevant to the department were added.

trasts. The high and mid-professionals, who have the most professional contacts, place a higher value upon these than do the other groups. The administrative group places a far higher value upon influence than do the other groups. As noted above, this group is composed of staff personnel who can only exercise influence, as they have very little authority. The three lowest prestige groups (subprofessional, clerical, and per-diem), who have on the average more experience and less accomplishments (if defined in terms of organizational goals) than the higher prestige groups, rank experience higher and accomplishments lower than the latter. The per-diem group differs from the others in some additional ways: they value security clearance—a measurable characteristic in which they might achieve the highest rating if their work requires it—far more highly than do any of the other groups; they value supervision, a characteristic which they cannot achieve, somewhat lower than do the other groups; and they value education, a characteristic which they do not have, slightly less than do the other groups. While there seems to be general agreement about the importance of the various criteria of prestige and esteem, the differences by and large reflect the characteristics of the various status groups. Characteristics which members of a status group have or can achieve are considered relatively important, while those which they do not have or cannot achieve are considered relatively unimportant. Finally, those items which are most closely related to role behavior are considered the most important, suggesting that esteem factors are an important consideration.

The personal goals of individual members in regard to their work are an important aspect of motivation and morale. In this organization both technical achievements and interpersonal or organizational success are important. The respondents were asked to check one among six personal goals. The results are summarized in Table 1. In general, the personal goals of members of the status groups reflect their different duties and responsibilities and the nature of their work. The research goals (a general research idea and an original formula) are more important for the professionals than for the other groups, and within the professional group they decrease in importance as prestige increases. This difference may reflect the emphasis of educational training

Table 1. Distribution of personal goals by status group.*

Personal goal	Status group							
	High prof. %	Mid-prof. %	Low prof. %	Adm. %	Sub-prof. %	Clerical %	Per-diem %	All groups %
A general research idea.....	10	10	25	0	4	3	4	8
Being a good fellow to work with.....	3	5	4	0	9	25	37	10
Developing useful equipment	21	22	12	0	45	9	26	24
An original formula.....	4	10	21	0	2	9	0	7
Organizing the work of a successful group.....	44	32	25	91	25	41	15	34
Applying a known principle to a new and important use	18	20	12	9	14	12	18	17

*The question read: "If you could achieve a wide reputation for just one thing, would you prefer to be known for [list of six items above]." Figures are percentages of persons in each group responding to each item, rounded to the nearest whole number. In some cases figures do not add to 100 per cent, due to rounding.

and the inexperience of the low professionals. The peer-interpersonal goal (being a good fellow to work with) is important mostly to the clerical and per-diem workers. The supervisor-interpersonal goal (organizing the work of a successful group) tends to increase as prestige increases, though it is particularly important to the clerical personnel and, at least among the choices offered, overwhelmingly important to the administrators. The applied research goal (applying a known principle to a new and important use) is intermediate in importance and varies little with status. The development goal (developing useful equipment) was most important to the per-diems and subprofessionals. This choice corresponds to their main activities in the organization.

ESTEEM

Though a number of individuals may have the same general status in an organization and thus be accorded the same prestige, the variations in the ways in which they perform their roles may

result in differences in the esteem accorded them. The esteem of a person may vary with the criteria on which he is evaluated and with the group to which he is compared. We have measured esteem by the number of preferences expressed toward an individual by others, on specific criteria and in specified groups.

A number of studies have shown a positive correlation between prestige and sociometric choice, i.e., expressions by individuals regarding others they would prefer to associate with in some way.[19] This correlation is seen in the tendency of individuals to prefer associating with persons of higher prestige, to "choose up."[20] But another reported finding is that individuals tend to choose others who have similar status and prestige.[21] This would appear to be in conflict with the apparent tendency to "choose up" and with the positive correlation between prestige and sociometric choice. The divergence in findings may be partly a function of the kinds of preferences individuals are asked to express. Individuals may select one set of associates for work purposes and a quite different set for recreational purposes. Thus one would expect a higher correlation between prestige and esteem when the sociometric criterion is a supervisor than when a work partner or friend is the basis for selection. Few studies, however, have asked for expressions about more than one type of association.

A second factor influencing the correlation between status or prestige and sociometric choice is the type and size of the group that forms the limits of the investigation. For example, sociometric choice within a community on the criterion of "desired friend" probably would show a high tendency for choice to be directed toward those of similar status or slightly higher prestige, while choice on the criterion of "desired committee chairman" probably would be directed toward those of high prestige. On the other hand, sociometric choice of friends and leaders within a "corner gang" would probably show a tendency for status, prestige, and esteem to be highly intercorrelated on both criteria.

In this study some attention was paid to both of these factors to allow for more specificity and meaning in the relations that

[19]See G. Lindzey and E. Borgatta, "Sociometric Measurement," in G. Lindzey, ed., *Handbook of Social Psychology*, I (Cambridge, Mass, 1954), 429.

[20]*Ibid.*

[21]*Ibid.*

were being investigated. Two types of organizational groups were studied, one characterized by primary relations and the other by secondary relations. The branches, varying in size from three to twenty-one members, are the closest approximation to permanent small groups in the laboratory. The department is the largest unit in which most persons are known to each other at least by reputation if not by personal acquaintance. Consequently, one set of questions was asked with reference to the branch, and another set of questions was asked with reference to the department. The main concern was to contrast choice within the small group, where primary relations and esteem are relatively more important, to choice within the department, where secondary relations and prestige are relatively more important.

The sociometric criteria were chosen to reflect the values and norms of the group. Informal discussions and interviews in the laboratory suggested the use of these three abilities in evaluating persons:[22] (1) technical ability, which would reflect skills, training and experience in engineering and science, (2) supervisory ability, which would reflect skill, training and experience in directing the work of groups, and (3) work partner ability, which would reflect skills, training and experience in working effectively with others. Some persons were seen as having considerable technical ability but as being inept or undesirable as supervisors or work partners. Only occasionally was a person seen as being a very capable supervisor and congenial work partner and as having little technical ability.

The major hypotheses investigated were: (1) prestige and esteem are directly related; (2) prestige and esteem are more closely related in a large group (the organization) than in a small group (the branch); (3) prestige and esteem are most closely related on the criterion of technical ability, closely related on the criterion of supervisor, and least closely related on the criterion of work partner; and (4) all three criteria of esteem are highly intercorrelated.

A detailed presentation of procedure and findings cannot be given here, but operational definitions of the variables, a brief description of the procedure, and some of the findings will be presented.

[22]See also Brown, *op. cit.*, and Brown and Shepherd, *op. cit.*

Prestige refers to the relative ranking of the status groups and esteem to the number of sociometric choices an individual received on a specified criterion and with reference to a specified group. Technical ability was divided into high (persons receiving one or more choices) and low (persons receiving no choices). Supervisory ability and work partner ability were each divided into positive (persons receiving positive choices only or more positive than negative choices), ignored (persons receiving no choices), ambivalent (persons receiving an equal number of positive and negative choices), and negative (persons receiving negative choices only or more negative than positive choices). Because there were very few individuals in the ambivalent category and their distribution was very similar to the ignored category, they were included in the latter for part of the analysis.

The data on each sociometric criterion for each status group were tabulated by branch and by organization and arranged in contingency tables. Chi-square was used to compute expected frequencies and to test for the existence of association.[23] Because there were only twelve administrators, they were omitted from the calculations.

Some persons were chosen for technical ability from among all status groups, but only the high and mid-professionals within the branch and only the high professionals within the organization were chosen more than expected by chance. Both Chi-squares were far beyond the .01 level of significance. This supports hypotheses (1) and (2), that prestige and esteem are directly related and more highly related when the organization is the limit of choice than when the branch is the limit of choice.

Some persons were chosen for supervisory ability from among all status groups with the exception of the clerical group. Only the high professionals within the branch and the high and mid-professionals within the organization were positively chosen more than expected by chance. All other groups were ignored or chosen ambivalently more than expected by chance. The mid, low, and subprofessionals within the branch and the high and mid-pro-

[23]Tables of the data on the esteem analysis and other analyses are available upon request from the Human Relations Research Group.

fessionals within the organization were negatively chosen more than expected by chance. Chi-squares were beyond the .01 level of significance. If one assumes that choices can be arranged along a scale of esteem from high to low and that high esteem is represented by positive choice, low by negative choice, and intermediate by ignored or ambivalent choice, the distributions of differences between observed and expected frequencies are seen to be U-shaped. When the branch is the limit of choice, the high professionals receive high esteem, the low professionals and all lower prestige groups receive intermediate esteem, and the intermediate prestige groups receive low esteem. When the organization is the limit of choice, the high and mid-professionals receive high esteem, all other groups receive intermediate esteem, and the high and mid-professionals also receive low esteem. This is partly consistent with hypotheses (1) and (2), though in an unexpected way. There is a curvilinear relation rather than a direct relation between prestige and esteem. When the branch is the limit of choice, high prestige persons are given high esteem, and intermediate prestige persons are given low esteem. When the organization is the limit of choice, high prestige persons receive both high and low esteem.

When the sociometric criterion is considered, these findings are meaningful. Within the branch the members feel that their present supervisor would be the most desirable supervisor and that some of their fellow workers would be the least desirable. Within the organization they feel that some of their present supervisors and some other high GS persons, as well as some of their mid-professional peers, would be the most desirable supervisors, while others in these prestige groups would be the least desirable supervisors. An esteem evaluation depends upon personal acquaintance or reputation. Within the branch personal acquaintance probably overrides hearsay; it is difficult both to like and dislike one's supervisor. When the organization is the limit of choice, however, reputation is probably as important, if not more important, than personal acquaintance. Occasional job contacts with persons in other branches or divisions and informal comments are directed toward those of high prestige. Hence,

higher-prestige persons are more widely known by reputation than intermediate- or low-prestige persons. For this reason negative as well as positive choices will tend to be directed toward those of high prestige, and particularly so when the organization is the limit of choice.

Some persons were chosen for work partner among all status groups. The high, mid- and low professionals within the branch and only the high and mid-professionals within the organization were positively chosen more than expected by chance. The subprofessionals and the clerical and per-diem workers within the branch and the organization, plus the low professionals within the organization, were ignored or chosen ambivalently more than expected by chance. The subprofessionals and the mid- and low professionals within the branch, and only the high professionals and per-diems within the organization, were negatively chosen more than expected by chance. Chi-squares are significant far beyond the .01 level of significance. A curvilinear relation is thus also present here. When the branch is the limit of choice high esteem tends to go to all professional groups and low esteem to the intermediate prestige groups. When the organization is the limit of choice high esteem tends to go to the two highest prestige groups, and low esteem to the highest and lowest prestige groups. Though work-partner esteem and prestige are related in much the same way as supervisor esteem and prestige, there are two major differences. The low professionals receive high work-partner esteem, and the per-diems receive low work-partner esteem. Both of these differences are probably due to the difference in the criterion and to the realities of the work situation.

These findings are consistent with the first three hypotheses, with the exception of the relation between high prestige and both high and low esteem. This discrepancy may be largely due to variations in the influence of personal acquaintance and reputation and the realities of the work situation. High-prestige persons appear to be the targets of strong feelings, whether positive or negative.

The interrelation of types of esteem was investigated to test hypothesis (4). When the branch is the limit of choice, persons tend to be ignored, positively chosen, or negatively chosen on both

work-partner and supervisor esteem. Those with high technical-ability esteem also tend to have high supervisor and high work-partner esteem (almost 50 per cent of the total). Those with low technical-ability esteem tend to be ignored or to be negatively chosen on both work-partner and supervisor esteem. Thus within the branch there is a strong tendency for persons to have high esteem, to be ignored, or to have low esteem on all three criteria.

When the organization is the limit of choice, the same general tendencies are present, though since reputation appears to be a greater factor, a higher percentage of persons are ignored. Those with high technical-ability esteem also tend to have high supervisor and work-partner esteem (over 50 per cent of the total). Those with low technical-ability esteem also tend to be ignored or negatively chosen on both work-partner and supervisor esteem.

These findings are consistent with the fourth hypothesis above, that esteem on all three criteria are highly intercorrelated. This may reflect the tendency noted in various sociometric investigations for esteem or liking to be diffuse rather than specific. This appears to be particularly true when reputation is a relatively strong factor, such as when the organization rather than the branch is the limit of choice. The relatively greater influence of personal acquaintance within the branch may make it possible for individuals to differentiate others better on the three criteria.

To control for the effect of variations in prestige, respondents were asked to make choices among branch heads, members of one prestige level. They were asked to indicate the branch heads who they thought had the highest technical ability, who "performs best (and poorest) the job of branch head," and whom they "would most (and least) like to have as a branch head." The results corroborate the findings above. Branch heads whose performance is considered best are also most desired as branch heads and are considered to have high technical ability, and branch heads whose performance is considered poorest are also least desired as branch heads and are considered to have low technical ability. Some indication of the effect of reputation is provided by the fact that when a branch head's own subordinates gave him high (or low) esteem, persons outside the branch did likewise.

CONCLUSION

The system of stratification in a research organization is subject to three major conflicting stresses: (1) the emphasis on the value of science and the attendant emphasis on objectivity, independent activity, and individual initiative; (2) the need for a functional type of organization which permits flexibility in work relations and yet is a part of a larger bureaucratic structure; and (3) the existence of status groups which are differentiated and stratified in a prestige hierarchy.

These stresses have various consequences for the administration of a research organization. The professionals are the elite of the organization, and subordinate groups tend to identify with them. This identification is no serious problem for the clerks, for they can obtain a type of vicarious prestige and satisfaction since they have almost no hope of becoming professionals. The administrators face the common problems of any staff group—they can offer advice, but their lack of authority places them in a difficult position. The subprofessionals identify with the professionals, but their age, experience, and seniority cannot overcome the influence of relative lack of education as a limit on their upward mobility. The per-diems do not identify closely, partly because of their organizational isolation and partly because of their relatively great differentiation from the professionals.

Various aspects of background characteristics, behavior and attitudes, and esteem reflect the differentiation and stratification of these status groups. Societal definitions and expectations, interpersonal relations, and a formal organizational structure combine to produce a very complex system of stratification.

George P. Bush
Lowell H. Hattery

Teamwork and Creativity in Research

Increasing magnitude and complexity pose major difficulties for the administration of scientific and technological endeavors. Traditional methods of administration frequently are inappropriate when applied to a scientific enterprise. The authors suggest that three areas in particular deserve more emphasis: (a) investigation of research organization, particularly with regard to the individual engaged in research; (b) training in research administration, from the bench scientist through project leader to the top administrator, and (c) effective communication, not across artificial disciplinary language barriers alone, but throughout the hierarchical form which is most conducive to research creativity.

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IN A world of increasing complexity, specialization is increasing and deepening in scientific endeavor and in the industrial arts. One finds, therefore, a need for an ever-increasing interdisciplinary approach, with the individual scientist spanning the man-made boundaries of the sciences and technologies. These bound-

aries are crossed not only by the individual, but also by groups which are constituted to bring cross-fertilization to the attack on a problem. In addition to multidiscipline teams, groups of like-trained scientists, strengthened by mutual reinforcement,[1] may approach a common problem.

When the needs of science lead to large-scale operations or require the solution of complex problems, particularly those that involve interdisciplinary groups, an element enters that transcends the traditional, basic training of the individual scientist— the element of coordination of the individual efforts. Without a favorable coordinative situation it is possible that group effort may actually impede the process of creative thinking and the progress of analysis, because of ineffective interaction among individuals of the group and with the administrative hierarchy. Working together, group effort, team attitude, team friction, and team harmony are intimately related to scientific progress. We must observe these phenomena carefully, factor them, and attempt to understand them. We must give increasing attention to ways in which to make teamwork more productive.

WHAT IS RESEARCH TEAMWORK?

The organization of research is inevitable for reasons which have been discussed elsewhere.[2] Teamwork in research is important in achieving a maximum creative contribution from the scientists of our nation's laboratories. Moreover, during a grim international science race, the nature of the creative capacity of our scientific personnel becomes of surpassing importance. Creativity resulting from group research is directly related to successful teamwork situations.[3]

"Organized research" and "group research" are terms used to describe the assignment of research problems to groups of scien-

[1]Development of the antibiotic oxamycin is an example of successful teamwork by intradiscipline and interdiscipline groups. This example is reported in The Team Approach, *Chemical and Engineering News* (May 16, 1955), p. 2066.

[2]See, for example, Lowell H. Hattery, "New Challenges in Administration," in George P. Bush and Lowell H. Hattery, eds., *Scientific Research: Its Administration and Organization* (Washington, D.C., 1950).

[3]For pertinent references on creativity, see topical index to references on this subject: George P. Bush, *Bibliography on Research Administration—Annotated* (Washington, D.C., 1954), p. 140.

tific personnel, who may be supported by a contingent of aides and by expensive equipment and who are supervised and evaluated by an administrative structure above and alongside them.

This same arrangement is sometimes identified as "team research." It is a phrase which has become increasingly popular in the last five years, especially for denoting multidiscipline groups. The increasing use of the phrase "team research," however, has perhaps detracted attention from "teamwork" in research. It is quite possible for a group of scientists to work on the same problem without the exchange of ideas and mutuality of effort which are characteristic of teamwork.

Another deterrent to full appreciation of the nature of teamwork is the tendency to generalize about the scientific activities of research and development as a single kind of enterprise. There is a critical difference, however. At the development end of the scale, problems of administration are comparable to other types of production activities. Toward the basic research end of the scale, on the other hand, scientific activities require substantially different arrangements of organization and administration for maximum contribution from the scientists.[4]

It is not surprising to note that the tendency is to apply traditional methods of management as they have been developed in business, government, and military organizations to the entire range of scientific investigation. In traditional administration the principal flow of communication is between administrative levels. In scientific research the principal flow of communication should be among the researchers at the same level. Yet this difference seems as yet to have been given little recognition by management. A recent statement by a research administrator, for example, referred to team research as nothing mysterious but "merely the use of specialists to solve the various phases of the problem."[5] The assignment of specialists to a single problem is by no means an assurance of teamwork.

[4]For a discussion of the differences in basic and applied or developmental research, see R. E. Gibson, "The Technical Team: Section T in Current Research Operations," in George P. Bush and Lowell H. Hattery, *Teamwork in Research* (Washington, D.C., 1953).

[5]Clyde Williams, Accelerated Progress through Team Research, *Battelle Technical Review* (Aug. and Sept. 1955), p. 96.

The problem of research teamwork has its origin in a true dilemma of administration. The dilemma is the question of control versus freedom of the activities of the individual researcher and of his group. Without control, assurance of pertinent and related activities is lessened, coordination is sacrificed, and essential information for administrative decisions is unavailable. On the other hand, without freedom of individual planning, consultation, and choice, the creative contribution of the scientist may be sacrificed. The research administrator needs to recognize the dilemma and seek the means which come nearest to achieving the necessities of control and the advantages of freedom.

WHAT IS MISSING?

As one proceeds up the administrative hierarchy, the failure to recognize the differences between research and development processes is more pronounced. Since the administrative methods at the higher echelons proceed without such recognition, these same methods tend to be repeated and perpetuated in the lower echelons.

A related yet distinct factor contributing to the kind of administration which does not develop teamwork situations is the shortcoming in the training of many research administrators. Research administrators have come from one of two principal backgrounds—either from administering nonresearch activities or from participation as a research scientist. The recency and the rapidity of growth of research programs has been responsible for a dearth of persons with dual training in research and administration.

It is obvious that much adjustment and new understanding is necessary for the person who is undertaking research administration. With the increase in formal literature, formal training, discussion conferences, and actual experience, the quality of research administration has risen rapidly. Many administrators, however, continue to rely heavily on the methods of administration which have been successful in nonresearch enterprise.

We believe that too little vigorous attention is given to the teamwork and human relations factors in scientific research in the United States, despite the forced development of extensive group research activity. There is still too much concentration on quantities of manpower in scientific fields to the neglect of the

means for the maximum productiveness of the precious supply we have.

As an example of complacency in the administration of research, it is of interest to note the trend in teamwork in the United States as compared with that in the Union of Soviet Socialist Republics. In the United States we have been surprised at the rapidity with which the Soviet Union has accomplished certain scientific projects. One of the keys may well lie in its administrative practices in science and technology, particularly the trends in teamwork.

In 1953 one of the authors drew attention to the growth of teamwork in the United States as reflected in the multiple authorship of articles appearing in the periodicals *Science* and *Industrial and Engineering Chemistry* during the period 1921–1951. He said, "It will be noted in these two charts that for both periodicals there has been a marked trend away from the single researcher to the team-research group. In fact the lone researcher is now in the minority."[6]

We extended the analysis of multiple authorship in these two periodicals to 1955. Two additional periodicals were also examined for the period 1921–1955: the *Journal of Physical Chemistry* and the *Journal of the American Chemical Society*. One would naturally expect a continuation in the trend toward teamwork research. The results were surprising, however, because the data in the three *scientific* journals revealed that the trend toward multiple authorship was reversed. Only in the case of the industrial technology journal, *Industrial and Engineering Chemistry*, was the trend upward in the percentage of articles authored by two, three, or more persons. Of course, one may ponder the relative contribution of each individual and, in the case of multiple authorship, the degree of teamwork, but over a period of years in applying the same criteria one can assume a relationship which is meaningful.

Because of the significant competition in science between the United States and the Soviet Union, we then made a comparative study of multiple authorship in certain Soviet journals which had

[6]George P. Bush, "Teamwork and Research: A Commentary and Evaluation," in Bush and Hattery, *Teamwork in Research*, p. 173.

some equivalence in content to the United States journals previously mentioned. The Soviet journals chosen for comparison were *Akadamii Nauk Doklady*, the *Zhurnal Obshchei Khimii*, and *Zhurnal Fizicheskoi Khimii*. The data examined revealed a contrast to the trend in the United States journals in that multiple authorship increased during the period 1951 to 1955.

The significance of this situation is difficult to assess. Such factors as changes in editorial policy, official attitudes toward multiple authorship, the unknown data of authorship in classified research reports, and other considerations may be reflected in the changes of trends in multiple authorship both here and abroad. As was previously suggested, there is also the question to what degree multiple authorship of scientific articles is in itself a valid indicator of research teamwork. These are questions which should be raised in evaluating both the data and its implications.

At the very least, the consistency of the data for the three United States and the three Soviet Union journals suggests that here is an aspect of our national research that warrants further and serious study. This conclusion is supported by the statements of others who are undoubtedly better able to compare the current scientific research effort in the United States and the Soviet Union.

In answer to the question "Did you feel the Russians had an appreciation of the value of pure research?" Homer and Norton Dodge, after their return from a visit to the Soviet Union, were quoted in a magazine interview as follows:

"Yes, very definitely. Perhaps a better appreciation than our own. Although we are spending in excess of four billion dollars a year on research in this country, this represents only a little more than 1 per cent of our GNP [gross national product]. This is pitifully small when one considers that a major part of the growth of GNP in the past fifty years has been the direct result of research. The situation becomes still more grotesque when we consider that less than 10 per cent of the research expenditures are devoted to fundamental research. It is vitally important that the National Science Foundation and other American organizations supporting and promoting fundamental research have their budgets increased."[7]

We would add to the Dodges' statement that in addition to in-

[7]Russia Gains over U.S. in Educating Scientists, *U.S. News and World Report* (Sept. 16, 1955), p. 102.

creasing the dollars available, it is equally significant to try to utilize resources in the United States with greater effectiveness through improvements in all aspects of the administration of research.

CURRENT OUTLOOK

Despite the negative picture painted above, there is a basis for optimism in the current outlook. The emphasis on interdisciplinary research, especially the attention to operations research concepts, contributes to recognition of the importance of teamwork and to attempts to develop formulas for maximizing it. For example, in some operations research teams a member is required to prepare research reports in which the language and the concepts are understandable by other members of the team though they are trained in different disciplines. The intercommunication through this forced exercise results in an exchange and a whetting of ideas that can result in creative advances which no single person of the group working by himself could have achieved. As operations research projects are conducted and the advantages of teamwork techniques are recognized, it may be anticipated that the techniques will find acceptance and adoption in research activities which are not identifiable as operations research activities.

Another development important to progress in teamwork is the increased use of high-speed computing equipment which extends the frontiers of research investigation, with the result that new areas are being explored which more than ever force a multiple approach to single problems. The increased consumption and production of data by computers places additional emphasis on teamwork.

A heightened concern for creativity is observable in the scientific world, inspired by the shortage of competent scientific personnel. The new emphasis on creativity is recognizable by the increased attention given to it in scientific journals and in discussion at professional meetings. Underlying the concern about "utilization" of scientists by government officials is the recognition of the importance of creativity. Industrial officials have a comparable interest in creativity because the economic importance of research progress by their own staffs is greater than ever before. The new emphasis in creativity will direct more attention to

probing the kinds of organizational, administrative, and group relationships which provide the best environment for creative productiveness.

WHAT NEEDS TO BE DONE?

We believe that management methods of business or government, including the military, must be changed when applied to research administration. In no other area is this fact so important as in the organization of personnel participating in a scientific research project. It is here that the team concept is vital. The achievement of a successful combination of persons assigned to the project requires at least three major components: (1) maintenance of leadership in some degree, (2) recognition of the necessary staff processes of administration, and (3) development of the fullest individual participation in those areas of individual competence pertinent to the research problem.

We suggest three types of effort for the extension and improvement of teamwork in scientific work in the United States and for the increase of creative productivity of the scientific task force. These suggestions are: to further research into the nature of teamwork and of creativity; to train in research administration at all levels; and to develop means for effective communication in research activities.

Investigation in Research Administration.

Despite problems of large magnitude and significance such as we have outlined, there is little support for investigation in research administration. In the early 1950s the Office of Naval Research supported pioneer work in this area, and the National Science Foundation is currently supporting some studies. They are remarkably restricted, however, when one considers the potential payoff for improved arrangements and processes for administering research programs and projects.

There are many possible approaches to investigation in research administration. Major emphasis might be directed toward more knowledge of the individual engaged in research, toward the nature of small-project group relationships, and toward the study of the relationships between the researcher and the administration.

An extensive myth has arisen about the scientist, and this myth

should be put to the test of close study. Is there a generic scientist who reacts and thinks creatively according to generalized rules and situations? Or does each scientist behave unpredictably as an individual? Or are there *X* categories of scientists, each category responding in predictable ways? How does one identify the categories? What are the ranges of behavior? What are the environmental factors which produce the greatest probability of realizing creativeness?

What combinations of individuals make up the most productive research group? Will a group of highly competent scientists who tend to be asocial produce better than a group of less highly competent scientists who tend to be social? What is the relative importance of adding a new specialist to the team compared with adding a new teamworker whose specialization is already represented? What is the relative significance of technical competence and the intensity with which scientific attitudes are held, in terms of creative productivity? How is the scientific attitude developed and intensified? How can the administrative personnel be helped to understand scientific attitudes and scientific methods? How can the balance between control and freedom be achieved? When does aid to the scientist reduce the scientist's own control over his research? What are the optimum arrangements for the researcher's participation in planning, operating, and reporting research activities?

These questions are suggestive of directions that study might take into three areas of research administration: the individual, the group, and the administrative organization. Such research is vital to the achievement and improved understanding of teamwork.

Training in Research Administration.

To professional trainers, the importance of training seems so obvious that it needs little elaboration. We do observe, however, that there are especially sharp needs for training in research organizations for four groups of personnel.

(1) *Administrators without training in science.* Line administrators in direct supervision over personnel trained in science and staff administrative employees not trained in science need to have training in the nature and history of science and indoctrination in the scientific attitude. Formal training in organized courses

and seminars can bring to their attention the benefit of what is already known about research administration.

(2) *Administrators trained as scientists.* These persons especially need formal training in research administration. They tend to apply too mechanistically the methods of administration they have observed or read about in nonscientific enterprises. Paradoxical though it seems, scientists very often become highly autocratic and inflexible administrators. One might say that scientist administrators are too often unscientific administrators.

Scientist officials need formal training through seminars and courses in both general administration and research administration.

(3) *Project supervisors.* These scientists are only part-time administrators whose principal administrative function is the supervision of a group of technical personnel. Although training courses in general administration and in research administration would be helpful to them in working with other administrative personnel and in preparing themselves for administrative positions, the prime need is to teach them the rudiments of group relationships. Training in the nature of individual motivation and in the dynamics of group relationships is important and may be achieved through the traditional courses in supervision adapted to the research situation.

(4) *Bench scientists.* The nonsupervisory scientist should be given some training in the nature of administration and of group relationships in organized endeavor. The frustrated bitterness of the supervised about "administrative red tape and stupidity" is no aid to creative activity. Understanding of the administrative necessities of life and of the essential nature of the teamworker should result in better teamworkers at the production level. No extensive training is called for, but an orientation as indicated is desirable.

There is no one agency or means for conducting the training for the four groups of personnel described. The training may consist of formal courses in administration available from most universities and formal courses in research administration now offered at universities in most of the important research communities, including the University of Pennsylvania, the University of Chicago, Columbia University, and American University. Training

may be offered by the organization as inservice training with instruction from either the staff or invited instructors. The use of contracts with university staffs to offer tailored courses within research organizations has relatively unexploited potential.

One of the difficult problems of training is to find instructors who themselves have an understanding both of traditional administration and of the nature of research. Engineering or industrial-management training does not qualify a trainer in research administration. For example, a schedule is one of the most important tools of the industrial engineer. It is also an important tool of the research administrator, yet *in research the schedule must not be master.* If it becomes the master, progress may be blocked. So the search for research trainers should be directed toward finding the person who has an understanding both of administration and of research, that is, of research administration.

Effective Communication in Research.

Effective communication in organizations has received substantial and constructive attention during the past ten years. The results of such studies can be useful to the research enterprise, although they provide only partial answers because of the special problems and the special needs of research.

Language and other barriers between chemist, mathematician, psychologist, and political scientist are substantial, yet each may be needed for a research problem. Even among subspecializations of a single field there are real communications barriers. To these barriers are added differences of personality, individual work assignments, physical distances in workplace, time consumed in communication, the effort in preparing written communications, and the skill required to communicate anything accurately. There are also barriers of pride in individual creativity and of the halting difficulty of discussing an emergent idea which is not yet clear in formulation.

Yet for maximum contribution from teamwork these barriers must be surmounted, eliminated, or by-passed. Systematic investigation of communication in research enterprise is needed. More case studies of successful experience should be reported. At present supervisors and administrators are limited to their own alert-

ness and to some suggestions from the general literature of administration.

Communication in research has facets beyond the immediate intercommunication of a research team. There are problems of external reporting and exchange of research results. There are problems of literature storage and retrieval, and of review and evaluation of research reports. There is the problem of vertical communication for administrative purposes.

Although progress is needed, and is being made, on all these fronts, our immediate concern is with team communication. Research and training are both needed to achieve the important progress necessary. Training should be directed both to project supervisors and to team members. Informal training can be very effective to help team members to improve their imparting and receiving of information and ideas.

CONCLUSION

Our scientific progress in recent decades has been tremendous and dramatic. Nevertheless, our needs for further progress are critical. There is danger that the hyperorganization of science may cause faltering in progress unless the organizational process is adjusted to the unique requirements of creative scientific research. Teamwork is one of the essential ingredients which can be improved through research, training, and improved communication —all of which will protect and aid an effective spirit of inquiry.

Development of Managers—Training in a Research Division

MANY recent articles dealing with management problems predict a serious future shortage of men to fill highly responsible positions in industrial corporations. Certainly the management problems of the future will differ from those of the present, which in turn are different from those of twenty years ago. The fact of any greater increase in the difficulty of management relative to increased difficulties in other types of work really remains to be established. Unfortunately it can be cogently argued, however, that the importance of good management in the national interest of the United States has increased during the recent period of conflict between the Western democracies and those nations subscribing to totalitarian philosophies.

It probably is safe to say, on the other hand, that the *awareness* of all managerial needs has become relatively sharper in the United States in the past two decades, a period corresponding to that of greatest ideological uncertainty that our nation has experienced. In other words, good managers are sorely needed, particularly in technologically oriented work requiring topflight leadership. Actually there never has been a time when, in any organized activity, public or private, there were too many of these employees having a sense of dedication to government or to corporate management.

In the Du Pont Company, periodic performance reviews and appraisals of the potential of employees are believed to provide a sound basis for the administration of a program of manager development in a chemical-manufacturing corporation. These systematic reviews and appraisals are conducted in a highly variable manner, of course, because

they are carried out by many individuals at the various levels of organization and in the various functional parts of the corporation. Desirably, however, all members of supervision in the lines of organization in this way participate consciously in the management-development program.

Company management has long endorsed the policy of "cross-fertilization," a term used to describe the directed movement of personnel between fields of work and between departments. Adherence to this policy has equipped a considerable number of management personnel with know-how in more than one phase of company business. Also, many employees have benefited by the counseling of different senior men having several ideas concerning optimum types of supervision. Continuous attention to the program has provided "feedback" that has resulted, in engineering parlance, in a sort of "controlled process" of manager development.

Cross-fertilization, among other types of movement in Du Pont, tends to level out differences of judgment concerning both the performance records and potential ratings of individual employees. Is the reputation of the man changed? Does the man have talent in one environment and not in another? Also, is the former supervisor a good one (poor one) or is the new supervisor better (worse)? Or is the man or the job requirement changing? Current centralized practice in the Du Pont Organization Planning Division includes analysis of supervisory personnel movement in terms of number of job changes, time on the present job, levels advanced, age, and history as to fields of experience. Estimates are made of current reserves and of promotability of these reserves, taking into account the probable shifts of job requirements. The statistical methods have varied over the past several years, and better methods are being sought to determine whether there is enough movement of the proper individuals at the proper times to produce a satisfactory cross-fertilization pattern.

Selection and training of potential managers has been well recognized in the Research Division of the Explosives Department of the Du Pont Company as a responsibility of each supervisor. Training in research surely conditions people to the fact that change is a good thing. Also, decision making sometimes may be poor because too few alternatives are considered; research is believed to foster expectancy that there *always* are many alternatives worth considering. (This is not to say, however, that a research organization is necessarily any better as a training ground on this score than are the manufacturing, sales, or finance branches of the corporate organization, all of which naturally slant their indoctrination efforts toward different primary goals.)

When factors important in research administration are listed, the one that easily ranks first is the performance of the *individual* employee. The complex of problems involving people in research organizations has been sorted over by many administrators and in many ways, often with stress laid on the factor of creativity as it can be brought to bear on technical problems. This paper is written to add a small piece of empirical information to the literature on a companion problem: fostering growth of men employed in a large corporate enterprise, a subject that challenges management to display creativity in a particularly fascinating and important area.

The Research Division of the Explosives Department is the oldest one of thirteen research organizations of the Du Pont Company. The division today has three research locations: Eastern Laboratory, established by a forward-looking general management in 1902 near the company's first dynamite plant, which now is the site of the department's principal chemical manufacturing activities; Burnside Laboratory, dating from 1931, which is adjacent to a smokeless powder plant, now converted largely to the manufacture of nonexplosive cellulose products; and the newest facility, which was activated in 1956 for long-range research at the Experimental Station near Wilmington, Delaware.

In 1934 the division undertook a diversification program in addition to continuing its work on explosives and propellants. Employment in the division has grown in the past twenty years in a manner paralleling the growth of the company as a whole. During this period, recognition of scientific competence as a factor equivalent to administrative competence has resulted, among other things, in the creation of appropriately rated research-associate jobs. To get best results, the thinking of differently trained people has been consciously pooled and "language" barriers have been surmounted by means of, and also because of, transfers of personnel among divisions and departments.

As indicated previously it is the belief in Du Pont that management personnel become equipped for their future jobs best by work in several phases of the company's business. Transfers are for on-the-job training, the understanding being that the man does *on his own* the tasks assigned him by the supervisors responsible for his unit's performance. Research is one such unit, and transfers for this work from outside departments or from manufacturing or sales divisions are primarily for the purpose of getting the research done.

In this manner employees are provided opportunities to enlarge their scope of knowledge, both by the different job content and by their relationships with different supervisors. Preparation for more important

management work is thus afforded men who have the capacity for the performance of jobs requiring greater perspective and entailing greater breadth of responsibility.

The part played by the Explosives Research Division in training over the past twenty years is shown in some detail in Table 1. In certain instances the data reflect multiple movements; for example, there are individuals whose classification is determined by their *last* transfer out of the Research Division but whose service and advancement records are based on their hiring dates (or January 1, 1936, if their service predated this cutoff point) and, in any event, on promotions only since January 1, 1936. Only male employees engaged in technical work were considered for this tabulation, and all of these men who were assigned to the division for specific, short-term training prior to assignment in sales or manufacturing activities have been omitted. Men who were hired, entered military service, and finally returned are not shown as having moved at all; men who subsequent to their employment have entered and still are in service have been eliminated from the tabulation; those who left Du Pont to enter military service and did not return to Du Pont are shown as resignations. The same treatment of data has been adopted for men who returned to school for advanced studies.

Table 2 shows in detail the reasons for transfers among divisions and departments of the company when Explosives Research Division was involved. These statistics are believed to be the most revealing ones for purposes of the present study.

The reasons for the moves differed widely: (1) a few very highly important ones were of a training nature because the men were rated very high in inventories of personnel potential; (2) some were made to test an expressed belief of the man that he would accomplish more in a new line of work; (3) some were made to test the belief of management that the man would do better in a different type of functional assignment; (4) most of them, however, were made to get a job done with the manpower immediately available, although decisions to effect transfers for this purpose often involved men not necessarily best suited *technically* for the work. The first three reasons often became coincident, single or in multiple, with the fourth.

It is clear from the data in the foregoing tabulations that a large net flow, both of men and experience, has occurred toward Explosives Sales from Explosives Research in the past twenty years; there also has been some net satisfaction of extradepartmental needs, especially for experienced men. These facts are interpreted as being indicative of

Table 1. Records of service, transfer, and advancement (levels of advancement per man per year) of men employed by Research Division since January 1, 1936.

	Men of Research Division origin		Men transferred to Research Division since 1/1/36		
	On roll 1/1/36	Hired since 1/1/36	From manufacturing	From sales	From other depts.
On roll 12/31/55	10	88	23	4	11
Service	200	373	189	52	120
Advancement	.190	.212	.190	.192	.221
Resigned	4	18	5	0	2
Service	21	67	33	—	6
Advancement	.190	.194	.182	—	.000
Discontinued	0	11	3	0	0
Service	—	30	11	—	—
Advancement	—	.033	.182	—	—
Pensioned	6	0	2	0	0
Service	74	—	40	—	—
Advancement	.027	—	.050	—	—
Deceased	2	1	0	0	1
Service	19	1	—	—	2
Advancement	.105	.000	—	—	.000
SUBTOTALS	22	118	33	4	14
	314	471	273	52	128
	.147	.206	.169	.192	.207
TOTALS	140			51	
	785			453	
	.182			.183	
	Men transferred from Research Division since 1/1/36				
Transferred to mfg.	19	26	34	0	0
Service	299	300	359	—	—
Advancement	.219	.247	.251	—	—
Transferred to sales	5	11	3	0	0
Service	99	122	36	—	—
Advancement	.212	.223	.278	—	—
Transferred to other depts.	7	9	3	0	0
Service	133	100	30	—	—
Advancement	.275	.260	.267	—	—
SUBTOTALS	31	46	40	0	0
	531	522	425	—	—
	.231	.243	.254	—	—
TOTALS	77			40	
	1053			425	
	.238			.254	
GRAND TOTALS	308				
	2716				
	.215				

Table 2. Reasons for transfers to and from Research Division.

	Training	Man wanted out	Better fit sought by management	Job opening
Reason for transfer *into* Research from:				
Manufacturing	1	2	2	31
Sales	1	0	3	0
Other departments	0	2	2	7
	2	4	7	38
Reason for transfer *from* Research to:				
Manufacturing	5	0	13	27
Sales	5	5	1	5
Other departments	0	3	5	8
	10	8	19	40
Reason, after transfer from outside,* for retransfer *from* Research to:				
Manufacturing	9	1	1	23
Sales	1	0	0	2
Other departments	0	0	1	2
	10	1	2	27
TOTALS	22	13	28	105

*All who retransferred were from Manufacturing except one, who came from an outside department.

(1) a rise in the requirements of the Explosives Department for technically trained people in marketing work and (2) a company expansion that has drawn heavily on the oldest department, Explosives, owing in part to conformity with a policy of promotion from within the ranks of employees to fill managerial needs. Also, there has been a large flow both in and out of the Research Division on account of manufacturing interests, the result being a substantial relative as well as net movement of both men and experience into the Manufacturing Division.

The very high flow from and to the Manufacturing Division can be accounted for by (1) similarity of the work being done by Research and Manufacturing and (2) pronounced inclinations of production management to equip high-potential personnel with some background of

research experience. Likewise, historically research management has wished to maintain a strong flavor of manufacturing sense in process-development programs that are expected to result in manufacturing activity.

Although the statistics of the present study do not show it, there are recent signs that the demands of programs involving more sales-oriented research may exert a relatively greater influence on future personnel changes between the Research and Sales Divisions.

It is believed that the small number of sales-to-research movements and the relatively very high net flow from research to sales of the past twenty years should be interpreted in the light of the following: (1) The time lag in the shifting of the Explosives Department during this period from explosives to chemicals-plus-explosives as a product mix; (2) The inherent difficulty of integrating into research pursuits any personnel lightly trained technically, (3) The obverse of (2), which is the relative ease of shifting highly trained technical people into various marketing assignments.

The present study leaves much to be desired from the viewpoint of statistical accuracy. A few probably valid general conclusions may be stated, however, if not proved objectively, in this article. These follow:

(1) Although corporate success admittedly cannot be equated with individual accomplishment, the Du Pont picture reflects a quiet resolve that employees be given great opportunity to display individual talents for outstanding leadership.

(2) The chance that a nonresearch man of outstanding general capability will reach a post of large manufacturing-, sales-, or general-management responsibility is improved if he is afforded an opportunity to do and/or appreciate good research, firsthand.

(3) There is no evidence that over-all research achievement is diminished when some bright people having principally nonresearch inclinations move into an organization that demands them to undertake *whole* jobs in the technical functions that are new to them; this remark appears to be true regardless of the job's manufacturing-problem nature and despite radical dissimilarities of marketing problems that are involved in the technical job assignment.

These statements are made in the light of the corporate history of the Du Pont Company over the past two decades and the fact that the Explosives Department during this period has been virtually a constant factor in both sales and earnings relative to the whole of the corporation.

Concerning not philosophical but eminently practical conclusions, the statistics of Table 1 include twenty-two men who, during the period

1936–1955, advanced by five or more organizational levels (average almost six) throughout an average individual service history since January 1, 1936 of about eighteen years to reach their present positions, seventeen of the twenty-two having attained it *outside* of the Explosives Research Division; there are twenty-four who advanced four levels in fifteen years' average service, fifteen of them now being in outside positions. To provide a reference scale, it should be stated that advancement in Du Pont involves from six to eight levels from the point of hiring to the highest point of functional responsibility in an industrial department (i.e., to Director of Research, Manufacturing, or Sales).

It is quite safe to say that the people who migrate through the research function cause no disruption in the conduct of research programs. Their indoctrination on their first assignments is handled by senior men who are conscious of the "total" problem. Their impact on the "permanent" research staff usually is evinced by a lift of enthusiasm, and the display of combined competences favors the research interest. At the same time, the fact of the equivalence of opportunities in sales, manufacturing, and research pursuits is recognized by the migrant and his coworkers. The practice of frequent movements into and out of a single divisional unit from and to both different functional units and different departments of the company provides the clinching argument against any rumor that men become "stuck" in any particular functional assignment.

From a research-administration viewpoint, it should be noted that the influx of personnel not trained primarily for careers in research should be handled with great care to avoid mismatching with "permanent" members of the research staff. On the other hand, but also from a research-administration viewpoint, every opportunity to improve research effectiveness should be taken by the exploitation of extrafunctional talents by adroit insertion of the new man into the research program.

The out-transfer of men from research may be determined by critical situations in other functions. Du Pont experience has been that properly assigned men, regardless of their origins, are easily transferred to outside assignments at mid-project points. That these sudden moves often are occasioned by expansion, and therefore are likely to be promotional, points up the advantage to the men concerned.

The lives of 308 people are involved in the activities covered by the present study. During the twenty-year period, the Explosives Department has had three general managers, four division heads in charge of research work, six laboratory directors (for both of the two older laboratories), and twenty-nine research supervisors (for all of the five

operating sections in 1936, growing to eight in 1955, exclusive in both reference years of all of the supporting professional technical staff sections).

The picture from a general-management viewpoint appears to be clear on several points: (1) there has been a consistent policy of encouragement by management and by functional supervision of the individual employee to work at and learn several skills, (2) the employees, regardless of their origins, by and large have accepted the principle that the research work assigned to them was worth doing, and (3) the men so assigned have produced valuable over-all results.

The men in Du Pont who appear in this article as mere statistics by virtue of their having passed through the Explosives Research Division are, on the record, doing much to further the interests of the company. Many of them have seen the article and agreed to its being published. They owe nothing to the present divisional organization, but they surely remember having been in it. Their attitude probably differs not one whit from that of their coordinate staff members, who in all likelihood have had equivalent experiences in other departments and functions of the Du Pont Company.

Although this paper has dealt primarily with the concept of cross-fertilization, it should not be inferred that Du Pont is unaware of, or inactive on, programs involving other facets of manager development. These include (1) supervisor-subordinate counseling, (2) individually personalized development plans; (3) supplementary training programs of a formal nature, and (4) contacts with professional societies and "out-company" development programs.

Of the foregoing, the interpersonal relationship between supervisor and subordinate is under particularly close and constant scrutiny. In many instances an employee considered to have capacity for growth is deliberately assigned to a different type of leadership so that by such exposure his managerial and administrative perspective may be broadened. Cross-fertilization obviously lends itself to this objective.

It is entirely possible that a more sophisticated approach to manager development may evolve in the future, but it is not expected that such programs will exert any profound influence on the procedure of carefully handled job rotation as practiced by the Du Pont Company and as exemplified by the Research Division of the Explosives Department during the period covered by the present study.

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Editor's Critique

Intellectual activities including scientific research traditionally have involved only two of the three dimensions of administration posited in the dedicatory article of this *Quarterly*.[1] These dimensions are the individual and his ecology—primarily his laboratory or library and his colleagues in the appropriate field of knowledge. Organized research involves adding to the rationality of individual researchers a larger measure of rationality in the relationships among researchers. The organization of research complicates the picture considerably, for it adds the entire dimension of total enterprise to the earlier individual and ecological dimensions.

As a method of developing knowledge, scientific research has seldom been a one-man show, of course. The history of science demonstrates that our great discoveries or breakthroughs have been the culmination of efforts by many independent researchers in scattered parts of the world. Typically, however, these researchers were linked only indirectly by exchange of observations, conclusions, and hypotheses, stimulated and defined by a professional ethic which called for complete and accurate reporting of procedures and results. For practical purposes these researchers operated autonomously, free to roam where their interests and rationality took them. When research projects become massive, the picture changes.

Perhaps the most dramatic illustration of successful organized research was the Manhattan Project for the development of the atomic bomb. It called for the efforts of many specialists, coordinated and synchronized in a race against time. The need for secrecy required "compartmentalization," so that few had definite knowledge of the relationships of their own work to that of others or of the ultimate

[1]See Edward H. Litchfield, Notes on a General Theory of Administration, *Administrative Science Quarterly*, 1 (June 1956), 3–29.

objective. That the Manhattan Project was successful called into question a number of beliefs concerning research which had been widely held by both scientists and laymen. But while it proved that organized research could be successful, the Manhattan Project did not and could not provide an unfailing pattern.

"Research" is a general term encompassing a variety of activities, spanning heterogeneous objectives, and involving many types of resources. It is fired by complex motivations; patriotism and an unusual sense of urgency and importance may have had much to do with the success of the Manhattan Project. Moreover, much of the intellectual equipment available had been developed under more traditional circumstances. Could organized research have provided the theoretical bases on which the Manhattan Project rested?

Distinctions between basic and applied research, or between research and development, have become increasingly bothersome, and satisfactory definitions are lacking. But if by the term "basic research" we refer to outcomes which open up new vistas and by "applied research" we refer to the immediately useful realization of those vistas, it may be possible to specify some of the differences in the requirements for these different research situations.

The results of basic research may be evaluated by asking whether a theory has been extended or verified, and the major "economic" consideration is that the theory be parsimonious. But the criteria for applied research are more likely to be in terms of "cost" or "efficiency" in comparison with alternative products. Thus the basic researcher may be successful if he can show that an atomic reactor can be achieved, but the applied researcher must find ways of making reactors that can compete on cost or efficiency terms with other techniques for producing energy.

The basic researcher, therefore, needs to be protected from the pressures or concerns which typically permeate the going enterprise—the firm, the hospital, or the government agency. His attention must be directed outside the enterprise into the ecology, and there to a set of peers who work in approximately the same field of abstraction and speak the same language, who will evaluate and stimulate his work on criteria grounded in theory.

The applied researcher, on the other hand, needs to be fully exposed to the usual pressures of product cost, sales appeal, production schedules, and so on. He must, therefore, be well integrated in the larger enterprise and in frequent interaction with those who will produce, use, and distribute his products.

Communication patterns therefore should be quite different for basic and applied research, and the character of administrative processes will necessarily differ in the two situations.

In both basic and applied research, however, much of the outcome still rests on the abilities of the human being, in spite of the development of complicated and costly equipment which has increased precision, control, and powers of observation. Machines and gadgets do not yet conceive of research projects or develop hunches, they do not design research strategy, and they do not spin theories. The essential reliance on the abilities of human beings does not make for easy organization of them into an enterprise.

Large-scale research involves the meshing of arrangements which facilitate the research process (time to think, freedom to pursue a new idea, and so on) with arrangements which facilitate organization (standardized rules of procedure which are not discriminatory, rationality, and so on.) Regularization is a major basis for organization; when the purpose of organization is intellectual creativity, many subtle questions arise, as the paper by Donald Pelz indicates.

The structure of the enterprise which is appropriate for research activities is determined in large part by the kinds of people who must be recruited for it. The attitudes, ideas, and values of scientists are, at many points, different from those of the general population and are especially different from those of people typically recruited into industrial or military enterprises. The result is that in many ways the research enterprise resembles the university or the hospital more closely than other types of enterprises.

Administered research also occurs in a variety of contexts. It may be sponsored through contracts and grants by governmental agencies, as Alan C. Rankin's paper discusses, and in this case questions of broad strategy become dominant for the agency, control is exercised largely through the allocation of resources, and problems of coordination are decentralized to laboratories or project directors. Research activities may be organized into a separate research enterprise, such as that described by John Kennedy and G. H. Putt, where objectives must be determined, resources acquired, allocated, and controlled and leadership exercised at a much more specific level than in the sponsoring governmental agency. Again, research may be organized into a department or division which is part of a much larger, nonresearch enterprise. Here numerous questions arise concerning uniformity of procedures and of rewards and penalties, as the paper by Clovis Shepherd and Paula Brown suggests. Here also, as R. M. Cavanaugh's paper shows, the research unit may have training as well as research functions.

In any event, it is certain that the stock solutions to organization and coordinative problems, developed for more typical activities in industry, the military, and government, are not directly transferrable to the research enterprise. "Planning," "directing," "supervising," and "standard operating procedures" must be modified. Discipline in the miiltary sense may be fatal to the research organization, and such devices as cost accounting face enormous problems when applied to research activities.

It seems clear, as George P. Bush and Lowell H. Hattery maintain, that standard administrative practices, and hence administrative training, cannot be applied to research wthout reassessment and modification —and research.—J. D. T.

Book Reviews

Anthropology in Administration. By H. G. Barnett. Evanston, Illinois: Row, Peterson and Company, 1956. 196 pp. $5.00.

This book could also be entitled "Anthropologi*sts* in Administration." It was inspired by Dr. Barnett's experience as staff anthropologist in the administration of the United States Trust Territory of the Pacific Islands. But it is much more than a reflection on an experience; it is a well-organized analysis of the role of a scientific specialist in a particular kind of administration—government of dependent peoples.

The first of five sections, "Knowledge and Policy," summarizes the use of anthropologists and of anthropological knowledge in other times and places, such as in the administration of dependent peoples in Africa, Indonesia, and the United States. For some readers, this section may be a more extensive compilation of information than is needed. However, it does establish the variety of methods employed, the difficulties encountered, and the implications posed as anthropologists have become native advisers, research consultants, and, occasionally, administrators.

Part II, "Prejudice and Principle," is essentially a study of role expectations: as the anthropologist sees himself, as the practical administrator sees himself, and as the two view each other. It is further a study of the dynamics of role adjustment as the two are tied together in an operating program. Part III, "Consultants and Executives," continues this theme but presents it by taking the reader through the real events which make up administration of dependent peoples in Micronesia. It gives the reader an unusually realistic view of the day-to-day tasks of a field anthropologist.

Part IV, "Means and Ends," continues the above and further describes the process by which the anthropologist adapts his methods and

objectives to the needs of the administrator, and the ways in which the administrator learns to use anthropologists most effectively.

In the last section, "Pros and Cons," the author searches the collective soul of the professional anthropologist as he brings into focus the conflicting values which make it difficult for one man to play simultaneously the roles of scientist, administrator, and private citizen. He thus joins scientists in other fields such as atomic physics, who must fit together their responsibilities to the demands of a scientific discipline, on the one hand, and their concept of human welfare, values, and ethics, on the other.

For the student of administration this book will have a twofold significance. In the first place it is an introduction to the working anthropologist, to his most traditional field skills and working assumptions, and to his most familiar milieu—simple societies. Add to this the airing of his concerns and loyalties, and an unusually comprehensive picture is presented.

Second, and perhaps most important for the reader who wishes to understand administration itself, this is a useful case study in the roles of the specialist and the practical administrator as they find their places within the confines of one organization. The process by which the administrator compromises his valued self-assurance to make way for a scientific assist in handling people is well presented, as is the struggle of the scientist as he ponders his own need for detachment and research in relation to the over-all need for immediate application, best guesses, and participation in an action program.

The reader should note, however, that anthropology is an excessively broad field, and the interests presented here do not reflect those of all anthropologists. This is not applied anthropology in the interdisciplinary sense of behavioral science, and a work on "Anthropology in Administration" which deals only with dependent and relatively primitive peoples appears to restrict unfairly the area of applicability of anthropological method and concept. This is not a shortcoming of Dr. Barnett's work, but a matter of appreciating the diverse applications of anthropological knowledge.

If it is of central interest in studying administration to note the process by which people with varying objectives weld their efforts into common action, this study should be most useful, especially Parts II, III, and IV.

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The Business Enterprise as a Subject for Research. By Howard R. Bowen. New York: Social Science Research Council (Pamphlet 11), 1955. 103 pp. $1.25.

In his essay "Principles of Research"[1] the late Albert Einstein observed that "in the temple of Science are many mansions, and various indeed are they that dwell therein and the motives that have led them thither. Many take to science out of a joyful sense of superior intellectual power; science is their own special sport to which they look for vivid experience and the satisfaction of ambition; many others are to be found in the temple who have offered the products of their brains on this altar for purely utilitarian purposes. Were an angel of the Lord to come and drive all the people belonging to these two categories out of the temple, it would be noticeably emptier,...they are largely, perhaps chiefly responsible for the building,...but there would still be some men, of both past and present times, left inside.... If the types we have just expelled were the only types there were, the temple would never have existed, any more than one can have a wood consisting of nothing but creepers."

Professor Bowen's monograph provides subjects of research chiefly for Einstein's "expelled types." For that purpose it is probably the most comprehensive and stimulating list of research topics in business, covering as it does the following suggestions for research (as well as many subsuggestions, too numerous to mention here): purchase and sale of business firms, location, capital investment determinants, short and long-run output determination, vertical integration, risk and uncertainty, relation to the different "publics," an analysis of major business functions; cost and demand analysis; the internal organization of the firm, its decision-making process, the nature and obligation of the firm, over-all results.

These research topics are summarized into three groups of important variables. The first group covers the "overt actions" of the firm, subjects of primary interest to the economist. The second group of variables consists of "environmental conditions" and "internal conditions," characteristics which include a kind of "culture" crucial to social sciences other than economics. A third group includes "the basic physical, biological, psychological, sociological, political and historical factors that explain environment and internal conditions."

Now these three major variables together with the long list of principal and subsidiary influences are more like a series of descriptions

[1]Albert Einstein, *Essays in Science* (New York, 1934), p. 1.

of specific aspects of business behavior rather than a general theory of business. "A theory should explain much by little," as Professor Milton Friedman of the University of Chicago has formulated its task so felicitously. Thus Einstein's theory of relativity was a mere four-page paper. The essence of some of the great theories of business behavior is similarly brief, such as Keynes's theory of business employment, Joan Robinson's theory of imperfect competition, Perlman's labor theory in terms of job protection, Fayol's theory of the administrative process. (In the comments on Bowen's book Herbert Simon appears to come much nearer to this requirement for a theory of business behavior than George Katona.)

Such a bleak statement of the *desiderata* for a theory does not deny the usefulness of Bowen's suggestions or the work resulting from it. In fact, most work on the firm is likely to be of that nature. A brick or two may be added to the edifice of the temple of science. That in itself as well as the pleasure engendered should be a good enough reward.

What appears to be objectionable and obstructive in building the temple is that the individual bricklayers sometimes claim they are building the whole temple. There is an attempt by an increasing number of bricklayers to construct their own theory entirely *de novo*. This then may lead to the foundation of a whole school. Gradually such a school acquires a staff, students, research, conferences, a library, large and growing funds. Even during his lifetime the founder of the school may build up a vast and often confusing verbal structure, without ever acknowledging any debt to his intellectual predecessors (even though he himself would not exist without them). Some create a special language, intelligible only to the initiated. Thus it happens that in the field of management research there rises a "management cathedral," complete with a management bible, commandments, rites, liturgy, inquisitors, crusades, and holy wars. Woe to those who stray beyond the dogma, who question infallibility--if they do not wish to be burned at the management stake, they had better fit themselves to the procrustean bed of inviolate management truth.

Fortunately the field of business research is still big enough, as Bowen convincingly demonstrates, so that all actual and potential researchers can make a contribution to the temple. My plea would be to give everyone who wishes an opportunity to participate in this grand enterprise. For much of the progress will be based on an analysis of actual experience. My plea would be for the use and acknowledgment of the work of other scholars, a free exchange of ideas, and no undue protection of "intellectual investments." Finally, I should make a plea for

modesty of our claims and gratitude for the few giants and few great theories which any one generation of scholars may be fortunate enough to produce.

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Health, Culture and Community. Edited by Benjamin D. Paul (with collaboration of Walter B. Miller). New York: Russell Sage Foundation, 1955. 493 pp. $5.00.

This volume consists of sixteen case studies concerning public reactions to health programs. The editor, Dr. Benjamin D. Paul, a social anthropologist on the faculty of the Harvard School of Public Health, has drawn cases from many areas of the world: South Africa, Canada, the United States, India, Thailand, China, the Pacific Islands, and numerous countries in Latin America. The cultures and communities range—in complexity of technology, economy, and social organization—from those of the peoples of Yap, an island in the Carolines, and the Zulu tribesmen of South Africa to the recipients of health programs in the city of Santiago, Chile, and a suburb of Boston, Massachusetts. For the most part the cases are focused on rural rather than urban areas. Most of the authors who have contributed cases to the volume are social scientists; the medical field is represented by several psychiatrists and an epidemiologist.

Paul has written brief introductions to each case and has related the analyses and contents of each chapter to both similar and contrasting cases in other chapters of the book. Additionally the editor has contributed an over-all introductory statement in which he outlines the arrangement of the cases, and at the end of the volume he has written a review of those social-science concepts which are illustrated by the various cases. These should be of value to doctors, nurses, health educators, and others engaged in public health work.

The language and the conceptual framework is that of cultural anthropology. The editor is to be congratulated for holding professional jargon to a minimum and for presenting well-organized and clearly stated cases. The result of his editorial skill is a book that can be understood readily by those in the medical field who have had little or no training in social science. The book should also be of considerable value to those anthropologists and sociologists who wish to acquaint

themselves with the problems which confront medical workers in the public-health field.

This book is also recommended to those in the field of public administration who have a particular interest in cross-cultural situations. A reading of such cases as those described in Kalvero Oberg and Jose Arthur Rios' chapter, "A Community Improvement Project in Brazil," and in Oscar Lewis' chapter, "Medicine and Politics in a Mexican Village," should be of great interest to administrators from the United States and abroad, especially those who are concerned with the introduction of new medical practices in less-developed regions of their own country or across culture barriers abroad. In the first-mentioned case the representatives of state and federal government failed to assess the processes and organization of local government. Technical assistance experts who looked to the United States for their patterns of assistance set up a community council in order to secure participation on the village level in a program involving health, education, and agriculture. These nonpartisan committees (like those through which extension agents work in the United States) were completely foreign to "a community geared to authoritarian personal rule by members of the party in power." As a result the program was a failure.

In the case described by Oscar Lewis a foreign research team (from the United States) established a clinical service in order to build rapport for their research program, only to have the latter attacked by local politicos. This was in fact an oblique attack on the medical service, which could not be directly assailed as it was of value to the community. In both cases, and in others presented in the volume, the local political scene was not sufficiently well understood to enable the successful introduction of a medical service.

The leitmotif of the volume is the importance of understanding the culture of the community where programs are being introduced; the social organization, the value and prestige systems, as well as the economy of the people to whom the medical programs are being introduced must be considered not as separate entities but in their interlinkages as a functioning system. To use the words of the editor:

> What appears from the outside as irrational belief and behavior becomes intelligible when viewed from within. Perceiving the connections between items of belief and behavior as the people themselves perceive them enables us to make better sense of the seemingly capricious pattern of acceptance and rejection, of successful and unsuccessful educational efforts.

The student of public administration should find of special interest the case written by Kaspar D. Naegele, "A Mental Health Project in a Boston Suburb." A team of psychiatrists, clinical psychologists,

sociologists, and anthropologists worked with the clergy and the schools in Wellesley in an endeavor to improve the mental health of the community, as well as to gain basic knowledge of the mental-health patterns. The success of the project was in part due to the conscious realization of differences in values between the professionals on the team. The essential division of labor resulted only when social roles were defined and it was discovered that "working together requires an understanding of irreducible differences and an agreement to differ in certain matters." The public administrator whose staff is composed of members who hold different value positions will recognize a familiar situation and find it well analyzed here.

Paul has demonstrated that he and his authors have an understanding of what social science, and anthropology in particular, has to offer those in the medical field—and, equally important, they have stated that message so that it will be read and understood by that audience.

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Individuals, Groups, and Economic Behavior. By C. Addison Hickman and Manford H. Kuhn. New York: Dryden Press, 1956. 266 pp. $4.75.

This book comes to the aid of economists stumbling in some of the identified marshlands of their discipline. On many questions of consumer behavior, incentives, effects of taxation, or managerial motivation, to mention only a few examples, economists find themselves on uncertain footing because these problems are complicated by an intertwining of behavior that is familiar to economic theory and of behavior that is not.

In three ways the authors show how social psychology can be used to extend the competence of economists in these areas by permitting us to analyze systematically and with some precision problems that we now often see vaguely and attack amateurishly. (1) They present, explain at length, and argue the usefulness of an orientation that they call "self theory," which embraces three key concepts: status, role, and reference group. (2) They illustrate the usefulness of both the general approach and these specific concepts by explaining three major applica-

tions of this orientation: first, describing managerial motivation; second, appraising possibilities for making interpersonal comparisons of utility; and, third, clarifying the issue of planning and freedom. (3) They survey the relevant research techniques of social psychology.

I risk injustice to the authors in attempting to explain in only a few words how they apply their concepts, but I shall try to capture the nub of two of the three applications.

The essence of the argument on interpersonal comparisons is that man derives his values from the social groups of which he is a member, from which it is held to follow that "we should ultimately find ways of pinpointing an individual in his reference group so accurately that we can predict from his reference group values to the individual's pattern of satisfactions" (p. 177).

On managerial motivation, the analysis of motivation becomes an analysis of managerial roles, for "the role is antecedent to the individual who adopts it. When he adopts it, he takes over as his own the socially approved plans of action which it comprises. They then become his motives" (p. 85).

Except for one qualification to be noted, the authors have done a useful task well. And my qualification turns not on a question of fact but of judgment. I find the authors to be somewhat doctrinaire; other approaches to economic problems through social psychology are, I believe, quite as helpful, each in its own place, as theirs. Offering "self theory" as an orientation (incidentally I think it does not quite deserve the name of "theory" although it is indeed an orientation), they feel called upon in their opening chapter to attack Freudian theory, field theory, and learning theory, creating unnecessary rivalry among approaches better seen as supplementary. Although well-documented, their attack strikes me as lacking subtlety, in which opinion two psychologists whom I asked to read the chapter agreed.

But this defect of the opening chapter, for those who believe that it is a defect, does not militate against the usefulness of the remainder of the book to economists who have not already introduced themselves to social psychology and discovered its potential contribution to economics. Even those who have done so will be interested in Hickman's and Kuhn's analysis of managerial motivation, interpersonal comparisons of utilities, and the planning-freedom issue, because each of these stands on its own feet.

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Leadership Qualities: A Theoretical Inquiry and an Experimental Study on Foremen. By Kullervo Rainio. Helsinki, Finland: Academiae Scientiarum Fennicae, 1955. 211 pp. No price given.

In 1950 Finland's Institute of Industrial Management assigned to the author "the task of developing a method of selecting foremen based on psychological tests"; the main portion of this book is concerned with a presentation of the results of his efforts in this area. Fortunately, Rainio approached his assignment with the conviction that "a clear theory provides a straighter path than a process of trial and error." It is his attempt to "achieve a coherent picture of the event of leadership" that comprises the most exciting and challenging part of the book.

The theoretical inquiry makes up the first sixty-five pages of the book and is a self-contained, highly compact unit. Unhappily it is also rather difficult reading. The English translation, while adequate, is often awkward; typographical errors and differences in style and notation are further distractions. When in addition the author speaks with the symbolism and concepts of Kurt Lewin's topological psychology, the readers' progress is laborious. The effort is nevertheless worth while, for Rainio competently and consistently strives for a systematic generalized description of the "act of leadership" and the "qualities of a leader" deducible therefrom. The "informal natural leadership" with which the theory deals directly is operative only within a group of interdependent individuals (i.e., comprising a "social field") and in the absence of outside influences affecting the structure of the group. Within these limitations Rainio defines the leading relation as occurring when "the behavior of x [the leader] causes the locomotion of y from A to B in such a way that the path from A to B is not in the direction the locomotion of y would have had without the said behavior of x." Postulating two main forces of the social field (cohesive and boundary), both created by the expectations members have of each other's actions and both acting to keep the individual within the group, and assuming that each individual has a "goal of his own" outside the social field, the author derives four "conditions of leadership." It is then suggested that to each condition there corresponds a personality trait essential to the fulfillment of that condition, a "leadership quality."

The conditions of leadership, derived directly within the theoretical framework, are statements of relationships of forces inhering in a "dynamic social field"; the leadership qualities are hypothesized as enduring characteristics of individuals; they are nonrelational, non-

situational. The author cites as the reason for this "approximate interpretation by means of non-topological concepts" the absence of "available experimental methods" for indexing the topological concepts themselves. A more cogent reason would seem to derive from the requirements of his research problem, which existed prior to and independent of this theoretical excursion.

Part II is devoted to a thorough, detailed description of a large-scale, long-term study of the characteristics of foremen. A total of 727 subjects were given various combinations of relatively standard tests (individual projective and objective, group and situational tests). Those obtained variables which were demonstrably reliable, relatively constant in time, and related to empirical criteria of leadership were then factor-analyzed, and four factors emerged. The experimental results correspond rather well with the leadership qualities posited in Part I and thus provide evidence of their relevance. Of course, as the author repeatedly points out, the experimental study was not designed to "test" the theory, and in fact it does not do so.

In general, given the experimental problem he had, Rainio is to be wholeheartedly applauded for what he attempts to do. Nevertheless, his book falls into two separate parts, and although he makes a valiant effort to link them together, the links are weak. The theoretical inquiry stands alone, and anyone with an interest in leadership—and at least a passing familiarity with Lewinian symbolism and jargon—will find in it some stimulating, carefully thought-out ideas. Part II is quite technical, and its interest would seem to be limited to those concerned with job-selection testing and/or techniques of factor analysis. Rainio is evidently a very capable and competent investigator. But although he himself states that he "does not wish to have the present study dismissed as just another 'trait analysis,'" it is difficult to avoid just such a dismissal.

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Methods in the Study of Administrative Leadership. (Research Monograph Number 80.) By Ralph M. Stogdill and Carroll L. Shartle. Columbus: Ohio State University Personnel Research Board, 1955. 77 pp. $2.00.

Patterns of Administrative Performance. (Research Monograph Number 81.) By Ralph M. Stogdill, Carroll L. Shartle, and associates. Columbus: Ohio State University Personnel Research Board, 1956. 108 pp. $2.00.

Leadership and Perceptions of Organization. (Research Monograph Number 82.) By Ellis L. Scott. Columbus: Ohio State University Personnel Research Board, 1956. 122 pp. $2.00.

The Ohio State Leadership Studies were initiated in 1945 by the Personnel Research Board at the Ohio State University as a ten-year program of basic research with the aims of developing research methods and obtaining information which might lead to a better understanding of leadership. Report Number 80 gives detailed information on the methods of studying leadership which have emerged from this program. As such, it represents a step forward in the healthy trend toward an empirical approach to these problems and away from the traditional speculative philosophical approach.

The Ohio State approach is a descriptive one. First, leadership is thought of as the behavior of individuals, such as naval officers, who occupy positions in which leadership is normally expected. Secondly, there is little emphasis on evaluating leader behavior as "effective" or "ineffective." The objective is, rather, to isolate significant dimensions of leader behavior which can be measured in various settings to provide information on what leaders do.

Through interviews and self-evaluations, information about leader behavior was sought from the leaders themselves and from their associates. The kinds of information collected may be briefly listed as follows:

(1) The nature of the organization, its structure, mission, and history, and the position of the interviewee in the organization and his concept of it.

(2) A study of organization charts, manuals, and the like. Interviewees were requested to draw the organization chart as they saw it; this was compared with the "official" chart and with other interviewees' charts.

(3) Collection of sociometric data concerning the interviewee's contact with superiors, subordinates, and peers. Various sociometric indices were derived from these data.

(4) Use of Thurstone and Likert-type scales to measure other dimensions. The interviewee filled out these scales about himself or someone else, or both. In this way, an attempt was made to assess such

variables as responsibility, authority, delegation, communication, representation, organization, integration, relations with subordinates, and relations with superiors.

(5) Use of work-analysis forms filled out by the interviewees. Work time was allocated percentagewise to various specified activities so that 100 per cent of the time was accounted for.

(6) Occasional ratings of individuals and organizations. Ranking methods were recommended for this purpose to minimize the error of leniency.

In studying a particular organization, personnel in both leadership and nonleadership positions were interviewed. Quantitative indices were derived on variables of the kind described above. These variables were then related to one another by a variety of techniques ranging from mere graphic presentation of the raw data to an elaborate kind of analysis resembling factor analytic techniques.

Perhaps the weakest area of technique development reported is that of dimensions based on items in Thurstone and Likert-type scales. Traditional methods of factor analysis and item analysis could be used to good advantage to develop scales with greater reliability and factorial clarity. This reviewer would also like to see future development in this area give more attention to characteristics of both the environment and the individual as they affect leadership. To be sure, Stogdill has emphasized that there is no generalized "leadership ability." Nevertheless, there undoubtedly exist individual traits by which leader behavior in a given context could be successfully predicted, even though the variables and regression weights would be different for another situation. Similarly, emphasis on the "situational" character of leadership should lead to a closer study of the factors in the situation that govern the emergence of leader behavior.

In Monograph Number 81, four studies are discussed which apply the methods described in report number 80. In the first of these, by Stogdill and Shartle, profiles for different classes of naval officers are presented with respect to the variables described in the previous report. The second study, by William E. Jaynes, compares scores on these variables for different kinds of naval officers and for different kinds of naval establishments. The third study, by Edwin A. Fleishman, compares naval and industrial organizations on the described variables. The fourth study, by Stogdill, Robert J. Wherry, and Jaynes, represents an application of Wherry and Winer's method of factor analysis to these same variables. Of forty-six variables analyzed, thirty-five were for time spent in different kinds of activities. Since these figures must add up

to 100 per cent, interdependence between these variables is compelled, rendering them less suitable for factor analytic work. There is no adequate discussion of the rotational criteria followed.

In the Scott study much the same data has been gathered from enlisted personnel as well as from the officers in a submarine squadron. The main part of the study is concerned with the enlisted men's concept of the organization as compared with that considered to be the official concept. Discrepancies between the viewpoints of various enlisted men, enlisted men with official concepts, and so on, are related to other factors such as individual and unit ratings of effectiveness.

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The Psychology of Industrial Conflict. By Ross Stagner. New York: John Wiley and Sons, 1956. 550 pp. $8.00.

This book aims at an important target, and while it does not score a bull's eye, it certainly must be credited with a respectable hit. Professor Stagner's substantive concern is with the broad field of union-management relations, and his conceptual emphasis rests on the individual, with secondary stress on group and institutional factors. The fundamental concern with an eclectic individual psychology is reflected in the organization of the book, with the initial part about one-third of all chapters, dealing with topics such as perception, motivation, and frustration and aggression. These chapters seemed somewhat more sophisticated and "solid" to this reviewer than subsequent portions of the book that are concerned with groups, leadership, and institutions, with the social processes of accommodation and cooperation, as well as with more "global" topics such as management and union tactics, strikes, and industrial peace.

The Psychology of Industrial Conflict typically seeks to summarize existing theory and generalization as a foundation upon which to build applications and examples drawn from a wide range of industrial situations. Available research findings are skillfully interwoven to buttress hypotheses, and the net effect is one of readability and consistency.

Undoubtedly it is difficult in a book of this kind to provide full and tight explication of all concepts and issues of theory. Still, in some instances key notions are either taken for granted, treated in a some-

what cursory manner, or defined a little too blandly. For example, on page 198, a group is defined as "a collection of persons pursuing a common goal," and on page 264, an institution is described as "a pattern of social roles supported by a system of expectancies and values." While later discussion in each case somewhat alleviates the state of oversimplification, it does not provide the kind of conceptual neatness that may be desirable. Certainly, a group also derives much of its "groupness" through the existence of social role patterns, expectancies and values, while conversely the pursuit of common goals may be viewed as one of many institutional attributes. The lack of neatness in theoretical formulation is evident elsewhere, as for example in the discussion of leadership. Initially, the concept of "leader" is used without much rigorous delimitation, but is dealt with solely in terms of broad functions. It is only in the course of later discussion that one gets a "feel" for the concept's meaning. The resulting constructs typically are descriptive rather than clearly operational or systematic. Throughout, there are numerous issues that would profit greatly by more explicit—even by self-consciously theoretical—treatment.

Stagner intends *The Psychology of Industrial Conflict* principally for advanced students in psychology rather than for practitioners. In the preface, he suggests that the book "is organized to provide a new frame of reference, sharply different from and yet essentially compatible with more familiar formulations in terms of economic issues and organizational structures." It would seem to this reviewer that the frame of reference is not essentially new, but that this lack of novelty in no way detracts from its usefulness. Well-tried psychological viewpoints are brought to bear upon a particular subject matter, and this application provides the student with good insights into the dynamics of a significant area of contemporary concern.

There are numerous charts and tables, most of them illuminating, and occasional quasi-Lewinian field diagrams, which are, perhaps, of less use. The twenty-five-page bibliography is excellent.

This volume constitutes a worth-while contribution to the study of administration in American industry. It is to be hoped that it will be followed by more detailed theoretical formulations that will integrate the current approaches and findings of the various social science disciplines.

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Work and Authority in Industry: Ideologies of Management in the Course of Industrialization. By Reinhard Bendix. New York: John Wiley and Sons, 1956. 466 pp. $7.50.

According to Reinhard Bendix, the owners and managers of industry face two problems in promoting and maintaining their positions in society. They must justify their claims to high status within the total stratification system, a problem particularly acute during the initial phases of industrialization, when these claims must be advanced against those of an already entrenched upper-status group. Further, the organization of industrial enterprises requires a work discipline more exacting than that of either the traditional crafts or peasant agriculture, and hence the owners and managers are faced initially with the task of transforming peasants into workers and during the later phases of industrialization with maintaining an efficient and willing labor force. To meet these two problems owners and managers evolved a succession of "ideologies" which provided justifications for their status claims and the demands they made of their labor force. Each nation presented a slightly different historical context, hence the ideologies evolved were generally tailor-made to fit the particular class system and cultural views of authority current in each nation.

To illustrate the articulation of ideologies and social structure, Bendix presents an analysis of four societies: England at the start of industrialization, Russia during the initial stages of its industrial growth under the czars, the United States during the first half of the twentieth century, and East Germany under Soviet domination. These four case histories permit Bendix to show how the problems of the initial phases of industrialization condition ideology as primarily a claim for status, while the problems of the later phases center about the maintenance of work discipline in a highly bureaucratized industrial organization.

In addition Bendix presents, somewhat gratuitously, an analysis of the trends in bureaucratization. While quite interesting in its own right, this analysis does not seem very well integrated with his main thesis. A final chapter, also appearing to be poorly articulated with the rest of the volume, spells out the implications of the differences in managerial ideologies in the United States and the Soviet Union. The data for Bendix's study are the usual documentary sources of the social historian. Secondary sources were relied upon heavily for the analysis of czarist Russia. The sources for the studies of England and the United States are familiar ones. The analysis of East Germany relies on material relatively inaccessible to most American scholars. At many

points the documentation seems somewhat excessive, leading to a discursive presentation in which this reader often lost the thread of the argument.

Bendix's analysis illustrates at the same time both the power and the deficiencies of the conceptual apparatus growing up around the notions of social class, ideology, and bureaucracy. On the deficit side, because these concepts are somewhat vague and connotative and are poorly articulated into a body of theoretical propositions, there is a great temptation to make *ad hoc* interpretations. For example, Bendix makes much of the trends in social origins of industrial leaders, but it is not clear what the mechanisms are which link such trends to other movements in industrial organization. On the credit side, any conceptual apparatus is better than none, and in the hands of as skillful and knowledgeable a scholar as Bendix, this particular one produces a valuable illustration of how social history may transcend the particular to become a generalizing discipline.

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Worker Satisfaction and Development: A Case Study of Work and Social Behavior in a Factory Group. By Abraham Zaleznik. Boston: Harvard Business School, Division of Research, 1956. 148 pp. $2.00.

This case study of a machine shop stems from the program for advanced training and research in human relations at the Harvard Business School. Zaleznik has tried, by looking closely at the men in one shop, to obtain new insights and hypotheses which could be subjected to testing in further research. In this attempt he has been successful.

The work group consisted of fourteen men, set off in a room by themselves. The workers' outstanding characteristic was their heterogeneity: they varied widely in job classification, hourly pay rates, age, education, and race and ethnic background. Significantly, too, some workers ranked high in one status factor and low in another; that is, there was considerable status inconsistency or rank disequilibrium. Zeleznik studied the group for six months, spending part of each day observing and informally interviewing the men.

The major portion of the analysis is centered upon the development of an effective social organization despite the heterogeneity of the work

group and despite the technological organization of the work, which did not require cooperation among the workers. The analysis utilizes George Homan's conceptual scheme developed for the study of small groups. The social organization of the group was abstracted by observing the patterns of interaction; a card-playing subgroup and a conversation subgroup was linked by an informal leader, who was discerned by the patterns of helping and lending of tools. I think it is an indication of the general applicability of some of Zaleznik's findings that the helping relationship also was found to establish a hierarchical relationship in Peter Blau's analysis of semiprofessional government employees. Some of Zaleznik's observations about aspects of the social organization are particularly intriguing. For example, he notes that the card-playing subgroups played so that a clear ranking of the players was impossible, and thus competitiveness was minimized. He also has some provocative ideas about the possible implications of status inconsistency for the leadership role.

Zaleznik summarizes his analysis of the social organization in the form of the following hypothesis: "Any work group will spontaneously order its relationships to reach [a] minimum state of effectiveness provided there are no major constraints impinging upon the group." Given this formulation, the author naturally turns his attention to a discussion of some constraining forces. This is suggestive. For theoretical purposes, however, we must be careful not to let the concept of spontaneity encourage us to study only constraints. Zaleznik is referring to the unplanned emergence of a social organization from the interactions of the men such as in helping, talking, or playing games with each other. This should lead us to specify the conditions which result in different kinds of interaction and the consequent variety of relationships. If the hypothesis were formulated with that in the forefront, it would encourage research in that direction; the concept of spontaneity is potentially misleading for research purposes, effective as it may be in directing administrative behavior.

By directing our attention to the variety of relationships that may emerge under different social conditions, we would prepare ourselves to answer questions about the sources of different group structures characterized by different norms. And these are important questions, as Zaleznik makes clear when he turns briefly, at the end of the study, to one of his most significant ideas in the monograph. He writes, "While a group operating in a fairly favorable environment can spontaneously provide for social satisfactions of members, it cannot alone become creative nor can it assure the personal development of its members."

We would like to know the conditions for the emergence, not only of an effective social organization, but of one or another kind of effective social organization. Zeleznik hypothesizes that the additional goals for work groups require the increasing of job involvement and the providing of a challenge to the workers; these are dependent upon developing "positive leadership functions" and utilizing discussion methods. He makes no mention of unions, work councils, or other institutionalized patterns of worker representation. Yet in order to assess the conditions for the emergence of different norms, we need comparative studies of plants with a variety of social structures (for example, codetermination and work councils), with differing degrees of heterogeneity and mobility within the plant hierarchy, with differing traditions of craftsmanship and professionalization among workers and managers, and with different supervisory techniques, since the techniques have different consequences in different settings.

This is a stimulating study. It should be of interest to every student and practitioner of administration. I am looking forward to the testing and amplification of Zaleznik's hypotheses, promised by Roethlisberger in the foreword to the monograph.

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Abstracts

Absentee-Owned Corporations and Community Power Structure. Roland J. Pellegrin and Charles H. Coates. *The American Journal of Sociology*, 61 (March 1956), 413–419. Available from the University of Chicago Press, 5750 Ellis Avenue, Chicago 37, Illinois. Single copy, $1.25.

This research report is focused upon the influence of absentee-owned corporations and their executives in the civic affairs of a southern metropolis. Data were gathered through interviews with the leading executives of the community and with other persons who had worked with and observed corporation executives. The active participation of corporation executives in civic affairs was shown to be motivated primarily by a desire to present the corporation to the citizenry in as favorable a light as possible and to maintain a zealous guard over the corporation's interest and prerogatives. The groups of executives are seen from this study to exercise a power in the community which is quite out of proportion to their number.

Business Leadership and Economic Development. Clark Kerr. April 1956. 4 pp. Available from American Association of Collegiate Schools of Business, 101 North Skinner Road, Station 24, St. Louis 5, Missouri. No price given.

In an address given before the American Association of Collegiate Schools of Business, the author comments on the role of the school of business in the ever-changing industrial society of today. He states that it is vital for both the external and internal safety of the United States that the number of managers and staff specialists increase; that the curricula of the schools of business will become much broader; and that research activity in the sphere of business will become more important in the future.

Business Leadership in the South. Clarence Danhof. *The Journal of Business,* 29 (April 1956), 130–137. Available from the University of Chicago Press, 5750 Ellis Avenue, Chicago 37, Illinois. Single copy, $1.75.

The comparative economic backwardness of the South can, the author believes, be attributed to a deficiency in high-level business leadership. He has therefore studied the distribution of business leadership between regions and states in the South, as compared with other regions. He discusses the reasons for the low level of leadership in the southern states and concludes that there is a broad and basic relationship between urbanization and the emergence of business leaders.

The Compulsive Pressures of Democracy in Unionism. John R. Coleman. *The American Journal of Sociology,* 61 (May 1956), 519–526. Available from the University of Chicago Press, 5750 Ellis Avenue, Chicago 37, Illinois. Single copy, $1.25.

The author of this article raises the question of what happens to a changing organizational structure that increasingly conflicts with the organizational values with which it is identified. Specifically, Coleman indicates that management pressure on unions for policy stability and decision-making efficiency plus the apathy of union members are among the factors involved in the increasing bureaucratization of union organization. At the same time the recognition by management, union members, and the public that union organization must be democratic sets in motion countervailing tendencies. The author discusses how the long-bureaucratized unions avoid the problems implicit in such a situation, and how the newer bureaucratizing unions develop forms for minimizing the potential conflict.

Concentration of Economic Power and the Economic Elite in Canada. John Porter. *The Canadian Journal of Economics and Political Science,* 22 (May 1956), 199–212. Available from the Secretary-Treasurer, Canadian Political Science Association, 273 Bloor Street W., Toronto 5, Canada. Single copy, $1.50.

This paper is the first of a series of analyses of elite groups in Canada. The object of the series is to determine the relationship between each of the groups and the way in which they emerge from the wider social structure. In this article the economic elite is discussed, and an account is given of the extent of the operations in the productive process of a group of corporations between 1948 and 1950. From this study the

author concludes that economic power in Canada is concentrated in the hands of an elite of 922 individuals holding 1,317 directorships in leading corporations in Canada.

Conference on Training in Public and Business Administration Report. 1955. 27 pp. Available from the Department of Extra-Mural Studies, University College of the West Indies, Mona, St. Andrew, Jamaica. No price given.

An outline is given here of the Conference on Training in Public and Business Administration, held under the auspices of the Department of Extra-Mural Studies of the University College of the West Indies in April 1955. The purpose of the conference was to review administrative needs in the public services, commerce, and industry in the West Indies. Consultants from Great Britain and the United States were present.

Control Structure and Union Functions. Arnold S. Tannenbaum. *The American Journal of Sociology,* 61 (May 1956), 536–545. Available from the University of Chicago Press, 5750 Ellis Avenue, Chicago 37, Illinois. Single copy, $1.25.

Pointing out that control in an organization can be regarded not only as an effect but also as a cause, Tannenbaum attempts to develop a descriptive technique for studying organization control and then to utilize this technique in exploring several hypotheses relating control to other aspects of organization. The descriptive technique is the control graph, a method of plotting control using the hierarchical aspect of organization as the abscissa and the amount of control exercised by any given level of the organization hierarchy as the ordinate. An effort is made to relate these two dimensions of control to prevalent ideas concerning membership participation, union ideology, and union-management conflict. It is further suggested that these three aspects of union organization and operation are part of a larger variable cluster relating organizational power, organizational conflict, participation, loyalty, and conformity.

The Effect on Academic Goods of Their Market. Warren G. Bennis. *The American Journal of Sociology,* 62 (July 1956), 28–33. Available from the University of Chicago Press, 1126 East 59th Street, Chicago 37, Illinois. Single copy, $1.25.

Two research groups in a large university are compared on the basis of data gathered by interviews with members of the groups. Both groups were financed by grants from a private foundation, but one had been established with a four-year grant, the other held a grant on a year-to-year basis. Data indicated that the former group was task-oriented while the latter group, because of its tenuous financing, was market-oriented, concerned with pleasing the foundation and with differentiating its product from that of other research groups.

The Electric Vehicle Company. John B. Rae. *Business History Review*, 29 (December 1955), 298–311. Available from The Editor, 217 Baker Library, Soldiers Field, Boston 63, Massachusetts. Reprint also available from the Massachusetts Institute of Technology, School of Industrial Management (Industrial Management Reprint Number 13).

The failure of the Electric Vehicle Company to monopolize the automobile industry at its inception provides what the author calls an illuminating example of business failure resulting from avoidable errors of judgment. The failure of the company is traced in this article, together with comments on the early history of the automobile industry in the United States.

The Essential Qualities of Good Supervision: A Case Study. Joseph K. Bailey. *Personnel*, 32 (January 1956), 311–326. Available from American Management Association, 1515 Broadway, New York 36, New York. Single copy, $1.75.

Mr. Bailey, of the College of Business Administration, University of Texas, describes a study conducted at the Kelly Air Force Base, Texas. The purpose of the study was to identify those factors that are considered most desirable for good supervision at Kelly. These qualities were determined by a questionnaire survey to which 769 employees responded. The questionnaire is included in an appendix to the article.

Executive Development in Action: Patterns and Techniques. Raymond L. Randall, ed. Pamphlet No. 9 (1955). 31 pp. Available from the Society for Personnel Administration, 5506 Connecticut Avenue, N.W., Washington 15, D.C. Single copy, $1.00.

An outline is given here of the main trends of thought at the sessions of the institutes sponsored in 1953 and 1954 by the Executive Development Work Group of the Society for Personnel Administration. Nearly

every federal agency was represented at the institutes, as well as twenty industries with significant experiences in the field of executive development. Only the concepts and techniques on which there was virtual unanimity of thinking have been reproduced here, with the aim of increasing the utility of the document for the busy reader who is looking for some quick way to familiarize himself with the major patterns and techniques of executive development.

The Federal Career Executive—In Transition. Raymond L. Randall. *Personnel Administration,* 19 (July-August 1956), 23–28. Available from the Society for Personnel Administration, 5506 Connecticut Avenue, N.W., Washington 15, D.C. Single copy, $1.00.

This article reports results of a survey of 803 career executives in the United States civil service. The average age of respondents was fifty-two, and average time in the service eighteen years; figures reveal the occupational origins and formal education of respondents, and the author concludes that educational emphasis had been substantive, with little attention given to the *processes* of administration or to cultural and historical trends. Respondents indicated a belief that supplementary training in those areas should be provided when individuals start to move from specialized to more generalized responsibility. The author suggests early selection and conscious development of executives, while also making specialist work rewarding for those without aptitudes or interest in administration.

A General Theory of Executive Compensation, Based on Statistically Tested Propositions. David R. Roberts. *The Quarterly Journal of Economics,* 70 (May 1956), 270–294. Available from the Harvard University Press, 44 Francis Avenue, Cambridge, Massachusetts. Single copy, $1.50.

In a study of the relationships between executive compensation, incentive, and mobility, the author applies current statistical techniques in an attempt to work out a general theory of executive compensation. He also attempts to fit executive compensation into the economic model in a fashion consistent with accepted theory and with the relationships already empirically determined.

Improving Staff and Line Relationships. Louis A. Allen. Conference Board Reports, Studies in Personnel Policy, No. 153. 99 pp. Available from National Industrial Conference Board, Inc., 460 Park Avenue, New York 22, New York. No price given.

This report is a study and analysis of the staff-and-line relationship as it currently exists in business and industry in the United States. The data on which this study is based were secured by personal interviews with over three hundred executives in seventy-eight different companies. Most of the major points developed in the study are illustrated with representative examples.

Interpersonal Trust as a Factor in Communication. Glenn D. Mellinger. *The Journal of Abnormal and Social Psychology,* 52 (May 1956), 304–309. Available from the American Psychological Association, Inc., 1333 Sixteenth Street, N.W., Washington 6, D.C. Single copy, $3.00.

In this article the hypothesis is advanced that a communicator who lacks trust in the recipient of his communication tends to be motivated to conceal his own attitudes about an issue, with the result that the perception of the recipient is impaired. Concealment may be accomplished in three ways, by evasion, by compliance, or by aggression, so that the recipient may be led to overestimate agreement in some cases, and underestimate it in others. Data for this paper were collected from a study in a large government organization devoted to medical research.

A Japanese Small Industry: A Letter from Kyoto. Lawrence Olson. *Explorations in Entrepreneurial History,* 8 (April 1956), 233–244. Available from the Research Center in Entrepreneurial History, Harvard University, 23 Holyoke House, Cambridge 38, Massachusetts. Single copy, $.75.

Based on interviews with owners and operators and observations in the shops of two family-related machine manufacturing enterprises, this is a description of some of the characteristics of the small (less than two hundred employees) Japanese productive organizations, which account for over 95 per cent of all Japanese manufacturing plants. Using partly a developmental and partly a synchronic approach, the author attempts to delineate some of the specific cultural characteristics of the small businessman and his organization in Japan and to indicate their significance for understanding this aspect of Japanese business and industrial organization.

Leadership Patterns and Organizational Effectiveness. No date. 20 pp. Available from the Foundation for Research in Human Behavior, Ann Arbor, Michigan. Single copy, $1.00.

Business leaders and representatives of research agencies participated in the seminars which are briefly reported here. Research findings on current problems of administrative leadership, motivation, and organizational effectiveness were examined in the light of the practical business management experience of the participants. The seminars were conducted by the Foundation for Research on Human Behavior in the spring of 1954.

Management Science in Marketing: Status and Prospects. Melvin Anshen. *Management Science:* 2 (April 1956), 222–231. Available from the Business Manager, Harold H. Cauvet, 250 North Street, White Plains, New York. Single copy, $2.50.

Scientifically controlled management practices in marketing are relatively backward when compared to the application of systematic methodology in the fields of production and general management. Also, within the field of marketing the status of management science varies from one of considerable progress in the area of marketing research to one of decided disorder in the area of managing sales-promotion progress. Mr. Anshen concludes his survey of the unimpressive standing of management science by noting several areas which present opportunities for the advancement of scientific management in marketing.

Marginal Policies of "Excellently Managed" Companies. James S. Earley. *The American Economic Review,* 46 (June 1956), 44–70. Available from the American Economic Review, 450 Ahnaip Street, Menasha, Wisconsin. Single copy, $1.50.

A questionnaire survey of 110 firms rated by the American Institute of Management as "excellently managed" is analyzed to reveal the use of marginal accounting analysis and marginalist viewpoints and policies. The basic principle of marginalism is to concentrate upon the differences in costs, revenues, and profits involved in decisions, and to neglect "inescapable" costs. Six component indexes of a firm's marginalism are set up: organization, availability of variable/fixed cost data, use of variable costing, use of separable fixed costs, pricing policies, and time perspective. Marginal accounting and costing principles have a strong hold among these companies. The companies also follow marginalist pricing, marketing, new product, and product-investment policies. Whether interested in short-run profits or long-run health, very few of the companies ignore the opportunities and/or necessities of practicing marginalism in the above range of problems.

Membership Participation in Policy-Making in the C.C.F. Frederick C. Englemann. *The Canadian Journal of Economics and Political Science,* 22 (May 1956), 161–173. Available from the Secretary-Treasurer, Canadian Political Science Association, 273 Bloor Street West, Toronto 5, Canada. Single Copy, $1.50.

This is a description of the origin and functioning of the farmer-labor-socialist Co-operative Commonwealth Federation of Canada. This party differs from other political parties in Canada in its emphasis on policy-making in delegate conventions. The author examines the actual extent of such participation and the way in which it is affected by its leaders, by allied groups, and by the parliamentary system.

The Michigan Department of Administration: A Case Study in the Politics of Administration. Ferrel Heady and Robert H. Pealy. *Public Administration Review,* 16 (Spring 1956), 82–89. Available from the American Society for Public Administration, 1313 East 60th Street, Chicago 37, Illinois. Single copy, $2.00.

This assessment of the political ramifications of the activities of the Michigan Department of Administration outlines the history and functions of the department, and points out the continual hindrance to the "housekeeping" functions of the department afforded by the supervisory powers of the semiobsolete State Administrative Board. Owing to the position of the controller of the department as secretary of the board, and the almost overwhelming political hostility between the board and the governor since the foundation of the department in 1948, partisan political warfare, the authors protest, has superseded attention to the administrative affairs of the state. The authors feel that the department's position would be ameliorated if the controllership were removed from partisan politics.

"The Pattern of Organization." Malcolm A. Taylor. Chapter IX, pp. 204–235 in *The Administration of Health Insurance in Canada.* Available from the Oxford University Press, Amen House, Toronto, Canada, 1956. Single copy, $5.65.

An examination is made of the organizational structure of the medical and hospital care plans in Canada and of some of the factors that help to shape the pattern of relationships in their administrative hierarchies. The influence of the objectives of the sponsoring body on the composition of the boards of directors is noted, as well as the question of who should be in control in the particular plan. The functions of

the various plans are shown to be highly similar, but the relationship of function to organizational structure has dictated organizational patterns which differ from plan to plan. The greatest differences appear between those plans that have organized their administrative units strictly on the basis of function and those that have grouped several functions into administrative units organized according to groups of clientele. The comparative youthfulness of medical care plans in Canada is shown in the dynamic nature of the various organizational structures.

Patterns of Organization for Applied Research and Development. Herbert A. Shepard. *Journal of Business,* 29 (January 1956), 52–58. Available from the University of Chicago Press, 5750 Ellis Avenue, Chicago 37, Illinois. Single copy, $1.75.

This paper explores the types of organizational structure most suitable for applied research and development. The "project" and "function" types of organization are considered from three aspects: first, the consequences for the careers and satisfactions of the personnel; second, the consequences in terms of performance; and, third, the consequences from the standpoint of administration.

Present Status of the Work of Managing. Harold F. Smiddy. *Management Science,* 2 (April 1956), 209–221. Available from the Business Manager, Harold H. Cauvet, 250 North Street, White Plains, New York. Single copy, $2.50.

The author attempts to establish the basic meaning of a science of management as a contributive social philosophy, rather than merely a set of tenets applied to business or industrial organization. He discusses the conditions which scientific management should meet, reviews the current status of the work of managing in America, and suggests an outline for a science of managing. This article is taken from an address delivered before the second national meeting of the Institute of Management Science in October 1955.

The Scientist's Contribution to Management. E. N. da C. Andrade. *The Manager,* 24 (June 1956), 437–443. Available from Management Publications, Ltd., P.O. Box 483, Management House, 8 Hill Street, London W. 1. Single copy, 3 shillings.

The author feels that in companies today whose efficiency, development, and progress depend upon the adoption of the scientific

method and the utilization of scientific research, there is not a sufficient link between the executives and the technical experts. In this article he advocates that on every board which has to deal with and direct any kind of technical and scientific process, there should be a scientist or scientists of standing, enjoying the confidence of the other members. In this way experts with professional scientific training and knowledge would be incorporated into the management team.

Trade-Union Government, Its Nature and Its Problems: A Bibliographical Review, 1945–1955. Daisy L. Tagliacozzo. *The American Journal of Sociology*, 61 (May 1956), 554–581. Available from the University of Chicago Press, 5750 Ellis Avenue, Chicago 37, Illinois. Single copy, $1.25.

This article includes a bibliography of 429 items on aspects of union-type organization. An introductory commentary to the bibliography offers a preliminary classification scheme for and an interpretive discussion of this literature. The major categories suggested are theory and method, trade-union government, rank and file, union leadership, and collective bargaining. The literature is then discussed in terms of the different points of view that have been expressed in the different areas of concern with union organization.